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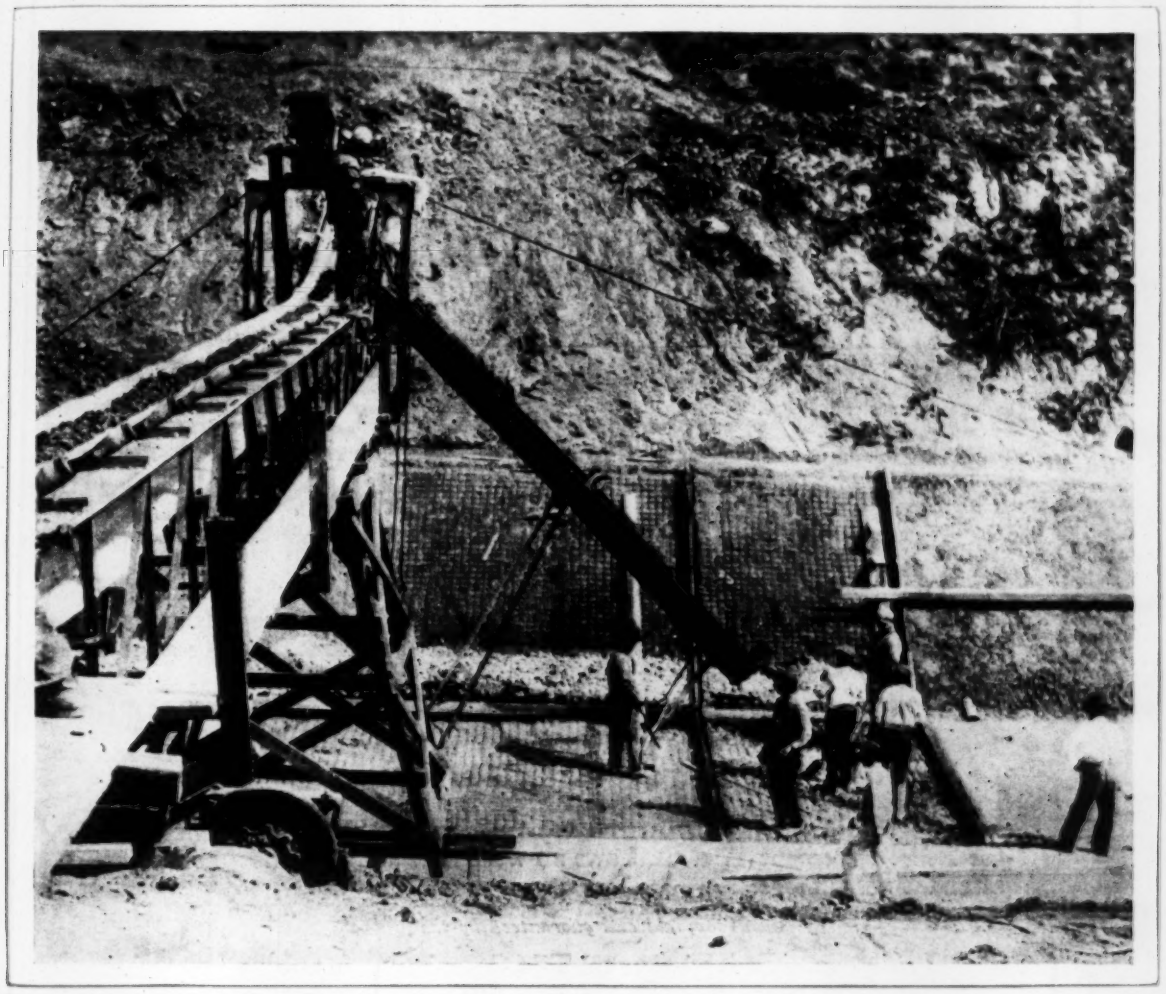
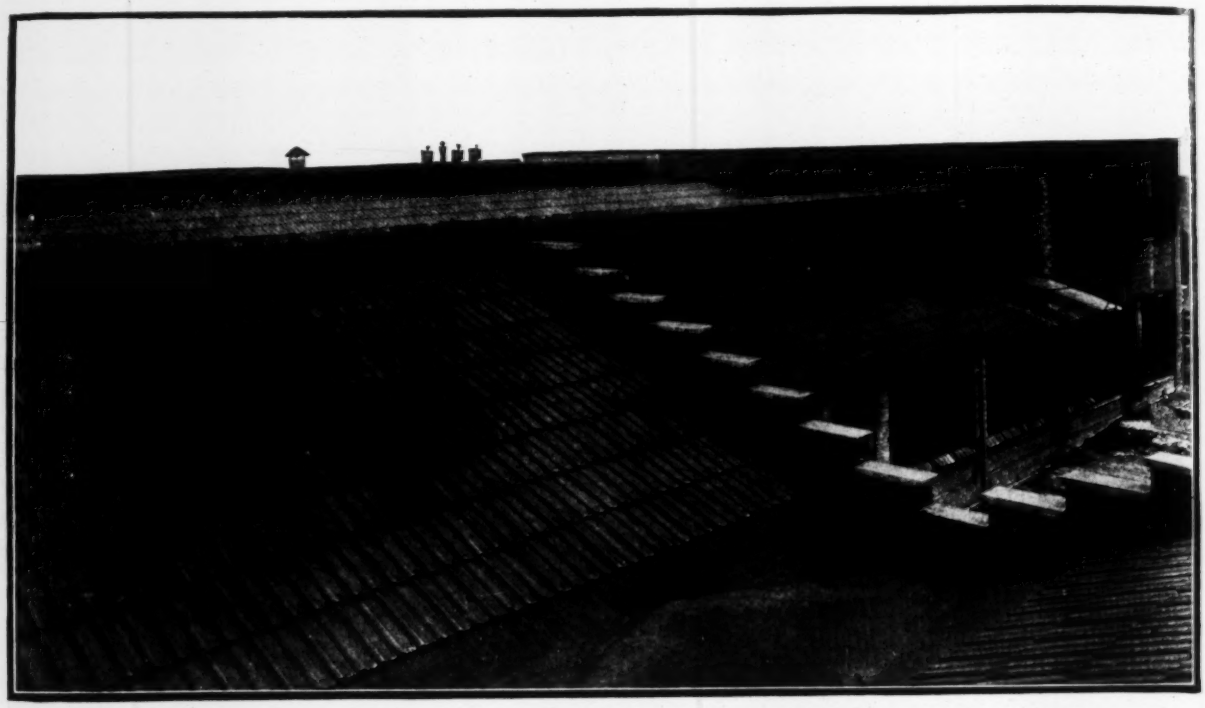


Concrete Delivered by Belt Conveyor, River des Peres Drainage Channel, St. Louis

Additional Water Supply for Boston and Worcester, Mass.—Highway Progress in the South Atlantic and Gulf States: Georgia—First Story Columns Cut Away in Building Enlargement—Arch Dam Repaired by Fills Above and Below Structure—Four Pages of Job and Office Articles



Buick Motor Company's foundry at Flint, Mich.; roofed with Federal Interlocking Tile; Federal Flat Slabs in gutter.

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ENGINEERING NEWS-RECORD

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FRANK C. WIGHT
Editor

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Scientific Research

A TRUE charge, but not an agreeable one, was made by Secretary Hoover in his address to the American Society of Mechanical Engineers last week. He charged that fundamental scientific research is too much neglected in America. It would be difficult to deny the charge. We have built up a great system of industrial research, and carry on a vast amount of study toward the solution of immediate problems of use and production, but we give little time to pushing ahead the frontiers of pure science. We are able to find large sums to subsidize investigations having a practical objective, while, on the other hand, it is very hard to obtain money for academic researches. Mr. Hoover proposed no remedy, nor could he well do so. His plea is an utterance of hope rather than a revivalist demand for action. Scientific research, the scientific spirit in general, is the expression of a prevailing intellectual attitude toward the outer world, at odds with the pragmatism that is much to the fore in our national habit of thinking. Change from one to the other must inevitably be slow. Under the conditions of today, the college president and the director of an industrial laboratory, when asking for funds, must expect to meet the current standards of what is worth-while—what kinds of activities and results promise to further man's wellbeing. In time, such standards will change from those founded on the slogan "Results count," of which Mr. Hoover himself is a leading exponent. For the present we cannot complain when the industrial laboratory directs its work exclusively to immediate problems of practice, or if the college glorifies discoveries and test results capable of immediate use. Both of them will broaden their attitude in time, and probably the broadening will come about sooner if we all will hope sincerely and strongly for the day of a higher scientific ideal.

A Millennium of Thrift

SIMULTANEOUS with this urging toward higher things comes discouragement in the news—we say news, though of course it may be a canard—that a thrifty philanthropist has done something which may render useless all attempts to improve the world. This benefactor has put a few dollars at interest in a savings bank, to grow steadily for a thousand years, after which the total sum is to be used for betterment work. The precise purpose is immaterial, as the amount will be so large that the wealth of the world will not be enough to pay for it, and if the unlucky savings bank which has the amount on deposit really tries to pay its depositor in full, there will be no world left to be benefited. Thus is realized at last the menace long apparent, that some one would hit on the device of putting the compound-interest law effectively to work, and would succeed in finding a quiet corner of the world sufficiently free from wars, bank failures, and other disturbances to permit the law to keep at work continuously. The present outlook is so strongly in favor of perpetual abolition of war that we need only an international federal reserve act and a few bank guarantee laws to make the chance of the depositor's cashing in appear very bright. It is to be hoped, however, in the general public interest, that before the thousand years have expired some congress or similar wise governing body will pass a suitable law that will put an end to the menace. All prior belief to the contrary, this particular case seems to show that thrift can be carried to an unhealthy extreme.

Will Congress Act?

THE Congress meeting this week has nothing more important or difficult among its many important problems than to establish a sound policy of public works. The issue is a broad one. It is most embodied in reclamation, but now or later its application is far more general, embracing all public-works construction without distinction. For Western reclamation by irrigation, Congress many years ago set up a partial gift system, under which, through the artful device of no interest charge on long-time installment payments, one-half to seven-eighths or more of the cost of the work was donated by the government. Had it done this, and then put the remaining debt of the local beneficiaries on a banking basis, all might yet have been well; but this was not done. The unhappy results of the financial system that grew up are now known. Nevertheless, various localities have continued to beset Congress with demands for money to develop their own projects. The last Congress temporized, by making appropriations and attaching a requirement that the states should undertake settlement. The states stupidly refused to co-operate, and the appropriations therefore were ineffective—fortunately. But the demands for such local "pork" have been and will continue to be repeated time and again. Present projects whose irrigation works cost the settler $30 to $70 per acre are in a state approaching bankruptcy (and would surely be adjudged bankrupt were they private undertakings); yet we find ardent advocates of such projects as Vale, Owyhee, Baker, Kittitas, and the like urging that the government appropriate millions of dollars to build their irrigation works, although they will cost from $130 to $160 per acre. In this conflict of fact and demand Congress has before it a problem worthy of statesmen. Can the government seriously propose to continue making gifts to local interests—usually local land-holding interests, who desire to sell out at a profit; or shall the government co-operate with the states in a definite system under which these local sovereignties will conduct the local administration and underwrite the federal loan; or, shall this entire work be turned over to a semi-public corporation—a thing rather unthinkable in the light of

the hostility which the Emergency Fleet Corporation has managed to arouse. There is some good argument, so far as irrigation of arid land is concerned, for advocating that the government abandon the work and leave it to local or private initiative; but there are other fields of public-works activity where this will not always be true. On the other hand, if a sound policy for public works construction having the feature of local benefits can be laid down now, the application of this policy can be made at any future time, with regard for the perfectly sound principle stated in the secretary's report: "Far distant operation by federal government cannot make a community a success."

No Settled Policy Yet

MUSCLE SHOALS is just as much of a problem today as it was before the five members of the President's Muscle Shoals Inquiry started their deliberations eight months ago, and the end for which the inquiry was appointed is defeated. Congress has no definite, well considered policy for the disposition of Muscle Shoals outlined for it. That was the chief reason for the appointment of the board of inquiry. To have the board submit two reports, one making specific recommendations and another, a minority report, tearing holes in the report of the majority and then adding recommendations of its own, leaves the whole matter more than ever a subject of controversy. Only one point is gained over conditions as they existed last spring; both reports voice their opposition to government operation, at least as a matter of principle. However, the majority report, after voicing its opposition to government operation, turns toward government operation "with great reluctance" because it has received no definite offer from a private concern of recognized accomplishment and financial standing. The minority report has the most to recommend it. It favors separate leases of the power and nitrate plants, to remove the temptation to divert power from the manufacture of nitrates in order to sell it at more profit for other and more profitable purposes, a temptation that would be present were the whole project leased to one concern. Separate leases are more likely to insure at least a fair trial of the use of electricity in the manufacture of nitrates for war purposes and for fertilizer. The recommendations of the minority in the matter of nitrate production are designed more to encourage the production of nitrates by electrical processes, the government's chief object in the maintenance of Muscle Shoals, than are those of the majority. In addition, the minority recognizes that as the electrical production of nitrates is in an undeveloped state no set amount of fertilizer to be produced should be specified at this time, as is specified in the majority report, because experiments may show that cheap fertilizers can be produced more economically by other means. When all has been said, the differences between the reports are not extreme and it would seem that some ground of compromise could have been found. Now, neither report is liable to receive much consideration from the new Congress.

A Temporary Interruption

LACK of space in this issue compels interruption of Dr. Terzaghi's valuable series of articles on soil mechanics. It is to be resumed next week with an article devoted to further comparison of sand and clay, begun in the issue of Dec. 3. This, in turn, will be followed by two articles, to appear in the issues of Dec. 24 and Dec. 31, closing the series which began with the study of cohesion in clay published in the Nov. 5 issue. The series of eight articles, though complete for the present, by no means exhausts or closes the subject, but represents merely a highly condensed outline of the facts so far developed in the mechanics of soils. These facts themselves, we feel certain, constitute only a small part of those which ultimately will be accumulated, and will form the basis for an improved engineering art. Even in its present form, however, the young science touches and revivifies every engineering activity concerned with soil.

Better Road Convention Programs

IN RECENT years the exhibition of equipment and materials has dominated the conference of the road-building industry held annually in Chicago. It is natural and desirable that this display feature should have become great. Indeed all road builders have taken pride in the growth. The technical work of the conference has also progressed. The evidence cannot be evaded, however, that progress in technical activity has been at a slower rate and has attained no striking position. There is discontent with this situation by many highway engineers.

It has been a common experience at recent conventions to have state highway officials announce that their interest in the convention proceedings was meagre and that they attended the conference and brought their engineers and constructors chiefly to see the exhibition. Indeed it has been increasingly evident to the technical program makers for several years that attendance on the convention proceedings was considered a perfunctory duty and often has been totally disregarded. Readers of papers have had scant audiences and scantier comment on their opinions and related experience. This condition is bad. Its evil is as great to the showman's side of the conference as it is to the technical side. The leaders of the exhibitors are as keen to the fact and are as anxious to see correction as are highway engineers. What is to be done?

Among associations of those concerned in highway work, there is only this one which meets annually at Chicago that represents the road-building industry in its entirety. The members of the American Road Builders Association are engineers, contractors, manufacturers, public officials—the whole personnel of the highway industry. It co-ordinates all elements of the industry as does no other association in the highway field. It cannot be replaced by the Association of State Highway Officials or the Highway Research Board. They have their own functions, highly important but distinct from the function of the American Road Builders Association. That organization cannot be allowed to disappear. Nor can it be permitted to wither in one of its branches while another branch grows sturdy. There must be symmetrical growth.

What is to be done? There are two tasks. One is to plan a professional program which will represent every interest of the membership. The other is to make the membership attend the technical meetings and take part in the program. Obviously it is possible to plan the program. To enforce attendance at and participation in the proceedings is equally possible. Indeed it is easily practicable. Virtually all who attend the convention and exhibition otherwise than as ex-

hibitors are delegated agents with paid expenses sent to gain information for the service of their principals. This is true of the attendants from state and county highway departments, of the contractors' superintendents and foremen and of the manufacturers' experts and salesmen. Let attendance at the meetings and discussions of the papers read be required of these delegates.

Does this seem fantastic? It has been tried and has operated. Last year certain highway commissions required of their delegates full reports of the convention proceedings and of the exhibits of importance. The reports showed that the department delegates had done what they had been paid to do. This year more highway commissions will require attendance and reports. It is a requirement on which every principal who pays the way for his experts to attend the Chicago road show and convention should insist. The demands of the technical program or of the hours of exhibition are not so great on the visitor as to leave him no time for entertainment. He can find full recreation and still do the work of informing himself and his employer of the data and exhibits which can be used in the year to come. Let him do it.

Filtered Water Recommended for Boston

THE march of time and the accompanying logic of events combined with the necessity for compromise that often arises in connection with delayed engineering projects that have become the subject of more or less controversy, account for some of the most striking features of the notable report on an additional water supply for the Boston metropolitan district and the city of Worcester made public on Dec. 1. Local traditions of long standing considered, the most striking feature of the report is its recommendation for filtration of both the present and additional supplies of the district. Next to this stands out the low total and per capita consumption of the metropolitan water district today compared with estimates made as long ago as 1895 and as lately as 1922. The unexpected decline in per capita consumption is largely due to the use of meters which, like the present proposal to filter the entire water supply for the metropolitan district, is thoroughly in line with the best engineering thought and the most progressive public policy throughout the country.

Compromise appears in the report as regards sources of additional water supply to be taken and, in lesser degree, as regards the recommendations for rapid progress in constructing filtration plants, the latter following naturally the decision of the present commission in favor of taking relatively nearby sources of supply instead of going well into central Massachusetts—although this feature of the report might perhaps be regarded more as a victory for the advocates of utilizing nearby waters than as a compromise.

In passing, it is only fair to call attention to the fact that the report of the Joint Board made in 1922 followed the main lines laid down by the State Board of Health in its 1895 report recommending the Nashua River as the first development and, when needed (then put as by 1915!) extension westward to the Ware and Swift rivers. In those days Massachusetts did not stand so nearly alone as it has in later years in its strong feeling for what used to be termed naturally pure waters as against those requiring filtration. Again, fairness to the makers of the 1922 report requires mention of the fact that they recognized the ultimate need of filtration of the entire metropolitan supply.

Two things are brought out in the report of the present commission that deserve careful attention throughout the country. The first point is that increase in total and per capita water consumption in the Boston metropolitan district has fallen far short of estimates made many years ago and made again in comparatively recent times. To what extent this is peculiar to the Boston metropolitan district deserves consideration in connection with all future water-supply reports for large centers of population. The second point relates to the decline in per capita water consumption. This must be in large measure credited to the use of meters, which within the last few years has gone up from 75 to 95 per cent of the services. As lately as 1922, the Joint Board concluded that, in view of experience in the metropolitan district and elsewhere, when a community has two-thirds or three-fourths of services metered, additional meters will have relatively small effect upon further per capita consumption growth. Nevertheless, instead of a per capita consumption of about 105 gal. in 1925, estimated by the 1922 board, the actual average daily consumption in the metropolitan water district in 1924 was only 95 gal. To what extent this may be due to other causes than the increase in metering may perhaps be gone into in the report of the commission's consulting engineer, Allen Hazen, which is not available up to the time of this writing.

On the many other subjects for comment that this interesting report suggests, mention can be made of two only. The first relates to the recommendations for filtration of the South Sudbury system and to the advice that no attempt whatever be made to utilize further the water of Lake Cochituate, except for emergencies—both these supplies having been kept in reserve for emergency use only for some years owing to poor quality. Under the leadership of Desmond FitzGerald, Boston was a pioneer in protecting the sanitary quality of its water supply through inspection, legal prosecution of polluters and contributions to the cost of diverting sewage outside of the water-supply gathering areas. Growth of population and industry in the Sudbury and Cochituate water-gathering areas exceeded the possibility of storage and control by any of the means indicated. It is likewise to be presumed that sanitary control could not have been effected so near Boston by wholesale purchase of watersheds. These things, combined with the reluctance of Massachusetts communities to adopt filtration and the fact that for many years the additional water supply from the Nashua River met all needs, have resulted in the disuse of the Cochituate and Sudbury supplies except for emergency reserves. This makes all the more interesting the proposal to restore the South Sudbury system to use by filtration.

Finally, the Boston metropolitan water district was the pioneer among the water and sewer districts that have since become common and of late years have been rapidly increasing in numbers. State control and state financing of the Boston metropolitan water and sewerage districts, together with the plans that have been followed in allocating interest charges, bond retirement and operating expenses among the various communities benefited deserve study wherever legislation authorizing water and sewerage districts in other parts of the country is contemplated.

Large Additional Water Supply Recommended for Boston Metropolitan District and Worcester

Investigating Commission Advises Creation of Special Commission to Develop Successively North Ware and Other Streams, with Filtration of Present and Additional Supply

ADDITIONAL water for the Boston metropolitan district and for the city of Worcester, Mass., to be provided in three installments totaling 180 m.g.d. during the next thirty years at an estimated cost of $85,500,000, both that and the present supply to be filtered, is recommended by the Metropolitan Water Supply Investigating Commission in a report filed Dec. 1 and noted briefly in our news section of Dec. 3. The Commission was provided for by the Massachusetts legislature of 1924. Among other things, the commission was directed to review "the findings and recommendations" of the Joint Board that reported on the metropolitan water supply in 1922, to consider "other feasible sources of water supply, including water purified by filtration," and to say how rapidly an additional supply should be provided.

The Joint Board of 1922 (see article with map, *Engineering News-Record*, March 2, 1922, p. 360) had advised taking the flood flows of the Ware and Swift Rivers, west of the present Nashua River (Wachusett reservoir) supply; and had recognized the ultimate need of filtration of the entire supply, but had not included the cost of filtration in its estimates. A minority report, by a single member (mentioned again at the close of this article) was against immediate provision of more water, and against going to the Swift River, although favoring further study of the Ware. This minority report, combined with opposition from manufacturers and others in central Massachusetts to the taking of even the flood flows of streams so far from Boston, caused legislative delay in acting on the Joint Board report and finally led to the appointment of the commission that has just reported, under a provision that of the special commission of three members one should be from one of the three counties in the drainage areas of the Ware and Swift Rivers, one from the city of Worcester, which is well towards the disaffected district and besides is concerned in the proposed additional supply, and only one from the Metropolitan District, and that one from Boston. Accordingly, the Governor appointed as commissioners Charles R. Gow, consulting engineer of Boston, to serve as chairman, George F. Booth, of Worcester, formerly editor of the *Gazette* of that city, and E. E. Lochridge, chief engineer of the water-works at Springfield. The commission chose as its consulting engineer Allen Hazen of New York City, who, acting under the authority of the commission, the report states, "at frequent intervals conferred with Leonard Metcalf of Boston" particularly on questions of "population growth and water requirements in Massachusetts, studies of the metropolitan distribution system and the present use of water for power and process purposes along some of the streams considered as possible sources of additional supply." Raymond C. Allen, an engineer of Manchester, Mass., was appointed secretary of the commission in addition to other duties of an engineering nature assigned to him.

The most notable feature of the present report is its decision against the Ware and Swift River project of the Joint Board except for taking a relatively small amount of water from the North Ware to be devoted in part from the outset and entirely later on to the needs of Worcester, and the putting of main reliance upon the utilization of relatively nearby sources, thus meeting the objections of the manufacturers and others at or near the center of the state that the metropolitan district was reaching out into their territory for water when sources nearer at hand, the objectors urged, would serve equally well. Almost as striking is the proposal of filtration for the entire additional as well as the present supply. Another feature of the report deserving special mention is the recommendation for the creation of a special construction commission to carry out the other recommendations of the report, including the detailed studies that will be necessary for that purpose.

The Joint Board of 1922 recognized that ultimately the entire metropolitan supply would have to be filtered and advised filtration of the South Sudbury and Lake Cochituate waters "when needed." The commission which has just reported believes that Lake Cochituate, which has a population in excess of 1,000 per sq.mi. of drainage area, should be held for emergency use only, when it could be depended on for 12 m.g.d. for the short periods it would be in use.

The commission's own summary of its recommendation is as follows:

(1) The present sources of water supply *of satisfactory quality*, available for the needs of the metropolitan district, can be depended upon to furnish an average output of not more than 119 m.g.d. during a series of exceptionally dry years such as frequently occur, whereas the district is now consuming approximately 130 m.g.d. and is called upon for additional amounts for other communities, with the probability that an even greater total amount will be needed in the immediate future.

(2) In addition to this amount of good water there is also available an existing supply of some 26 m.g.d. obtainable from the South Sudbury system, the present natural quality of which is so unsatisfactory that for many years past it has been used only in extreme emergencies and for short periods when there was no other alternative. This supply can be made equally satisfactory or better than that now used by constructing suitable purification works at an expenditure of approximately $3,500,000 which will thereafter assure to the district a total safe capacity of 145 m.g.d., sufficient according to our estimates to meet the probable water needs of the district until about the year 1929. Before that date, therefore, there must be developed some new supply if the danger of a probable water shortage is to be avoided and the period required for constructing such works will probably be not less than four years under the most favorable circumstances.

(3) The city of Worcester is in an even more critical state respecting its water supply than is the metropolitan district since it is already experiencing an actual shortage of supply and has been compelled to purchase from 5 to 6 m.g.d. from the metropolitan district for several months past and to pump the same from the Wachusett reservoir into its own system. This water used by Worcester is in addition to the 130 m.g.d. now being consumed by the district itself.

(4) Additional water, suitable for the future needs of the metropolitan district and of Worcester, may be secured by developing the Ware and Swift rivers for that purpose, as originally suggested as a future possibility at the time the metropolitan system was created, and as recommended still more recently by the Joint Board so called, which reported upon the subject in the year 1922, or otherwise various smaller developments may be utilized which can be added to the system from time to time in the future as the demand for greater quantities of water occurs.

(5) The Ware and Swift river project as recommended by the Joint Board would, if carried out, more than double the present capacity of the existing supply, including that proposed to be reclaimed by filtering the South Sudbury water, and would care for the combined needs of the metropolitan district and of Worcester for perhaps as much as 75 years into the future. This source would yield a water of excellent natural quality and its cost *per million gallons of capacity* might be as low as that of any other source or sources which can be suggested as substitutes. The entire investment, however, would have to be made substantially at once for an amount of water which would not be required for many years hence or possibly never if by any chance the growth in population were for any reason to cease or decline.

(6) The taking by the metropolitan district of the waters of the Swift and Ware rivers together with the large areas of land required for reservoirs and protective measures is strongly objected to by the communities in that section of the state because of what is deemed to be unnecessary encroachment upon existing local rights and benefits pertaining to these natural resources. Also, the proposed method of utilizing this source would not meet in a satisfactory manner the requirements of the city of Worcester for an addition to its present supply, since all of the water which that city might secure from such a development would have to be elevated several hundred feet by pumping and its taking would necessarily be subject to such restrictions and regulations as might be imposed by the metropolitan district.

(7) There is however a possible solution of Worcester's water supply problem which would seem to be advantageous alike to that city and to the metropolitan district. By constructing a dam across the Ware River in the vicinity of Barre Falls a large reservoir would be created in the valley above that point which would have a capacity of 45 m.g.d. which could be made to flow by gravity either to some of the existing reservoirs of the Worcester system, to the Wachusett reservoir or to both. Since the amount of water which would be made available by this means would be considerably in excess of that required by the city of Worcester for a very long future period there would remain during that time a substantial surplus which could be utilized by the metropolitan district to augment its present supply and thus to defer the occasion when additional sources would be required for the enlargement of its own system. The estimated cost of developing this supply is $14,000,000.

(8) In addition to the supply obtainable from the North Ware, it will be possible, whenever it is needed, to secure 47 m.g.d. of additional supply by diverting certain branches of the upper Assabet River into the Wachusett aqueduct which passes through the watershed of that river on its way to Sudbury reservoir. The cost of such a development will be approximately $8,500,000.

(9) When the time comes for securing more water than these two sources are capable of delivering, the Ipswich River above the town of Topsfield can be developed as a third source of supply capable of yielding 80 m.g.d. of which 30 m.g.d. may ultimately be required for the water needs of communities in or adjacent to the Ipswich valley. The remaining 50 m.g.d. could be pumped to the metropolitan system in the vicinity of Spot Pond. The total cost of this development at present prices would be in the neighborhood of $19,000,000.

(10) The Hobbs Brook reservoir of the city of Cambridge water supply can be greatly increased in size by raising the present dam some 30 ft. If this were done it could be kept full by pumping water from the lower Sudbury River during seasons of flood and by such means the capacity of the supply might be increased 50 m.g.d. The cost of this development would be about $12,000,000.

(11) The total additional supply which can ultimately be secured by developing successively the North Ware, Assabet, Ipswich and Hobbs Brook sources will be 202 m.g.d. and the aggregate cost approximately $53,500,000. These figures compare with approximately 200 m.g.d. obtainable from the Swift, Ware and Millers rivers at a cost as estimated by the Joint Board in its 1922 report of $60,000,000.

(12) The water obtained from the Assabet, Ipswich and Hobbs Brook sources would require filtration before using while that of the North Ware supply, if used in considerable quantity, might tend to lower slightly the present quality of the Wachusett water with which it would necessarily mix in passing through the system. On the other hand, unless very considerable sums are expended in the near future in the purchase of property adjacent to the Wachusett reservoir, for the preservation of the purity of the supply, it is doubtful if resort to filtration of that water can be much longer deferred.

(13) The Quinebaug River has also been considered as a possible source of future supply. Considerable quantities of water of excellent quality might be obtained from this source at a cost comparable with other supplies studied but since sufficient water is obtainable from nearer sources, no recommendation is made at this time regarding this supply.

(14) Aside from the matter of securing some new source or sources of supply, there is also involved the important question of bringing the additional water thus obtained into the metropolitan district. Existing demands require the full capacity of available conduits from the Weston terminal of the Weston aqueduct to the centers of distribution. Certain engineering studies which have been made in the course of this investigation indicate the desirability of constructing a deep pressure tunnel in the underlying rock between the Weston terminal and a point in or near the city of Everett. The estimated cost of such a tunnel is $17,000,000. In addition, some present deficiencies of capacity in certain sections of the Weston aqueduct itself now require correction at an estimated expense of $700,000.

(15) In view of all the facts outlined, we recommend:
(a) That a special construction commission be created with authority to improve and increase the present water supply of the metropolitan district and of the city of Worcester.

(b) That the commission should immediately construct a suitable filtration plant for making available the waters of the South Sudbury system.

(c) That the commission also should proceed immediately with the construction of a reservoir on the upper Ware River for the joint use of the city of Worcester and the metropolitan district.

(d) That an agreement should be entered into between the city of Worcester and the Commonwealth whereby the latter shall construct the said reservoir and its necessary appurtenances, the city contributing one-ninth of the actual cost of same in return for the right to take one-ninth of all the water thereby made available, with the further privilege of taking from time to time in the future additional amounts of water when needed, in increments of one-ninth each, paying therefor one-ninth of the original cost for each one-ninth of the supply of water so taken and in addition contributing to the annual cost of maintenance and upkeep in such proportion as its taking of water bears to the capacity of the entire supply.

(e) That the commission be authorized to purchase land at a suitable point along the Weston aqueduct for the location of a future filtration plant of sufficient capacity to filter the amount of water capable of being carried by said aqueduct.

(f) That the commission be empowered to purchase or take by right of eminent domain such land, rights, easements or other property within the watersheds of the Assabet and Ipswich rivers as it may determine to be necessary for the proper protection of these sources against future encroachment by private interests and for preserving the sanitary quality of their waters.

(g) That the commission be instructed to study and to report their recommendations to the general court on or before Dec. 1, 1926, as to the need, location and estimated cost of delivering the future water supply to the distribution system of the metropolitan district either by pressure tunnel or by pipe lines.

(h) That the legislature appropriate the sum of $27,500,-

000 and that proper authority be given the said commission for expending the same in carrying out the foregoing recommendations.

Chronologically the commission's recommendations fall into three construction periods of a decade each, as follows: (1) $47,500,000 for the construction of the North Ware portion of the project; the initial installation of South Sudbury filters; supplementary siphons on the present Weston aqueduct required for its full utilization, the proposed pressure tunnel from the present terminal of the Weston aqueduct to the heart of the metropolitan district; miscellaneous construction necessary from year to year in connection with the metropolitan supply; and the purchase of land and rights for the future Assabet and kindred supplies. (2) $24,000,000 for the construction of the Assabet system, filtration of Wachusett (present Nashua River) supply and of the Ware and Assabet water; changes in reservoirs on account of filtration; building reservoir on the Ipswich supply; and minor yearly enlargements. (3) $14,000,000 for completing Ipswich filters and pipe line, for additional Sudbury filters and for minor yearly enlargements to existing works.

Of the total estimated outlay of $85,500,000, the report states, $31,500,000 will be for 180 m.g.d. of additional water; $5,000,000, which would be necessary under any plan, for filtering the South Sudbury supply, making available 26 m.g.d. not now being used because the quality is unsatisfactory; $24,000,000 for filtration made necessary by the use of the more highly colored waters, subject to possible pollution, already mentioned, but which at the same time makes it possible to use 8 m.g.d. more than at present from the Wachusett Reservoir; and $25,000,000 to get the additional water supply into the district and to pay for year-to-year construction. The total outlay of $85,500,000 would be reduced, so far as the metropolitan district is concerned, by whatever was paid by Worcester on account of the North Ware supply taken over by it.

To bring the Joint Board's estimate of $60,000,000 for the development of the Ware and Swift supply into comparison with the recommendations of the present commission, adjustments have to be made, the report says. These include $25,000,000 for distribution needs covered in the present report, $5,000,000 for the Sudbury filters, and $8,000,000 for other items, bringing the total figure up to $98,000,000 spread over fourteen years while the present commission's $80,000,000 estimate would be spread over thirty years. The cost per million gallons under each plan is substantially the same, the report says, putting the figure at $490,000 per m.g. whereas the present commission plan provides for all filtered water. Against this, however, there should be charged the cost of filtration not needed in the Swift River scheme of perhaps $500,000 a year or if capitalized $12,000,000.

Under the new plan the various municipalities supplied wholesale would be required to pay $102.50 per m.g. up to 1939 as compared with $120 for the Joint Board scheme by 1931 with reduction for later years.

The Joint Board scheme of 1922 was in substantial accordance with the original report and recommendations of the State Board of Health in 1895 on which the metropolitan water supply development was based —that is, to continue going westerly from the Nashua River—except that the Joint Board passed over the taking of some of the minor streams when it recommended the huge storage reservoir on Swift River.

In discussing the probable life of the present supply (which the report shows as already attained in the case of very dry years) some very interesting facts were brought out as to the effect of meters and other unexpected and underestimated factors that have kept the per capita consumption down. It was estimated in 1895 that the Nashua River or Wachusett reservoir supply could serve the districts only until 1915, but several towns that were expected to come into the district have not yet come in and the rate of increase in population prior to 1895 and assumed for subsequent years declined. Moreover, the Joint Board of 1922 overestimated the increase in population between 1920 and 1925, "the estimated gain in population for these years having proved to be 28 per cent in excess of the actual increase." Should this discrepancy continue until 1970, the Joint Board forecast of 2,500,000 population to be supplied at that date would be reduced to about 2,218,000. The actual estimate made by Mr. Hazen for 1970 puts the population figure at 2,140,000 for "the present water district." The report points out that all population estimates are liable to error so "that our own engineer's forecast of 2,140,000 is not necessarily the minimum number to be anticipated."

Coming now to per capita consumption figures, the report states that due to the "progressive installation of meters" per capita consumption is now "only slightly larger than when the works were installed 30 years ago," but it must be remembered that 95 per cent of the water services in the district are now metered. Even since 1920 the per capita consumption has fallen from 105.5 gal. to 95 gal. in 1924. During this time the percentage of metered services increased from 75 per cent to the 95 per cent already mentioned.

Besides the nearly twenty cities and towns now supplied by the metropolitan water system, the special investigating commission estimates that the following 11 of the 15 within ten miles of the State House will need to draw some or all of their supply from the metropolitan system "in the not distant future": Cambridge, Canton, Braintree, Dedham, Needham, Wakefield, Waltham, Wellesley, Weymouth, Winchester and Woburn. To these 11 within, there should be added 4 outside the 10-mile limit that, the commission believes, may need the help of the district, as follows: Norwood, Reading, Weston and Westwood. The four towns within the 10-mile limit that do not seem likely to need water from the district are: Hingham, Hull, Lynn and Saugus.

The Joint Board of 1922 (created in 1919) was composed of the members of the State Department of Health and the Metropolitan District Commission. The chairman of the latter, James A. Bailey, submitted a minority report against immediate action on going to the Ware and Swift Rivers but favoring study of the Ware River possibilities. He urged that additional water would not be needed by the metropolitan district before 1935, basing this on the possibility of a further checking the increase in consumption and on the slow growth of the district. X. H. Goodnough, chief engineer State Department of Health, was chief engineer for the Joint Board of 1922, with Bertram Brewer as principal assistant. The Joint Board had as consulting engineer F. P. Stearns until his death in December, 1919, and then J. Waldo Smith, New York City.

Road Progress in the South Atlantic and Gulf States

South Carolina	Louisiana
Georgia	Florida
Alabama	Mississippi

An Editorial Field Study of State Road Organization, Policies and Plans; the Trend of Highway Thinking; the Status of State Control; and the Progress in Engineering and Construction in Six Southern States

By John W. Shaver
Assistant Editor, *Engineering News-Record*

II—Georgia

EVER since its organization the Georgia State Highway Department has been the object of state legislative investigation. That has been five successive years, for the now existing department began to function after the highway law of Aug. 18, 1919, was passed. In the explanation for such investigations lies a story of constant education of the state to the necessity for a state-owned and operated system of highways carried on by one of the most efficiently organized highway departments of the South. And through the years since its organization W. R. Neel, state highway engineer, who incidentally has survived much longer in state highway service than the average chief engineer, has piloted the department through pretty rough waters, always keeping the supervisory force clear of politics. Also, with little money on which to operate, and that supplied mostly by the counties, the state is practically free of sectionalized influence and the roads have been put in passable condition. Only during the past year has new construction been given anywhere near ample financial aid. The department is now provided with a great deal more money than it has ever had, and the program for the coming year calls for the expenditure of approximately $6,000,000 for new construction, and almost half that for maintenance.

Legislative investigations, which have been made with the exception of that carried out this year by joint committees from the state legislature, have been due entirely to misunderstanding of the state highway function. The reasons for investigations have usually been specific. There have never been any general charges of incompetency. It has merely been a matter of the general assembly being somewhat jealous of the new organization, and of the willingness of a few individuals to listen to high and wide adverse criticism of the department with no basis in actual fact. In other words the investigations have usually been educational sorties into the management of the department and the administration of its funds. The latest investigation, that carried out by a committee from the 1925 senate (the house refused to join this year), was asked by the state highway department, when it became known there was some dissatisfaction over a few details of contract letting. So the state is gradually becoming accustomed to the administration of a state system by a state organization, and the expenditure by that body of sums heretofore unheard of for highway expense, yet sums which are comparatively low for the work done and the mileage of good highways acquired.

State Highway Department—The first step toward organization of a state highway department was taken in 1916, after the passage of the Federal Aid Highway Act. In order to take advantage of federal aid the state had to have some means of administering the funds and of raising other funds to match federal aid. Accordingly, the 1916 legislature wrote the following law, which, it is believed, is sufficiently interesting to reproduce in full excepting the preamble caption:

Section 1. Be it enacted by the General Assembly of Georgia, and it is hereby enacted by authority of the same, That from and after the passage of this Act the Prison Commission of Georgia, together with the State Geologist, the Dean of the College of Civil Engineering of the State University, and the Professor of Highway Engineering at the Georgia School of Technology, shall constitute the Highway Department of the State of Georgia, and shall discharge all the duties prescribed by the Act of Congress approved July 11, 1916, known as the "Act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes," to be performed by such State Highway Department, which they shall do without additional compensation to that now paid them, and under the provisions of the Act of 1908, allowing said Prison Commission to employ such civil engineers as therein provided.

Section 2. Be it further enacted, and it is hereby enacted by the authority of the same, that the assent of the State of Georgia is hereby given to the terms and provisions of said Act of Congress referred to in Section 1.

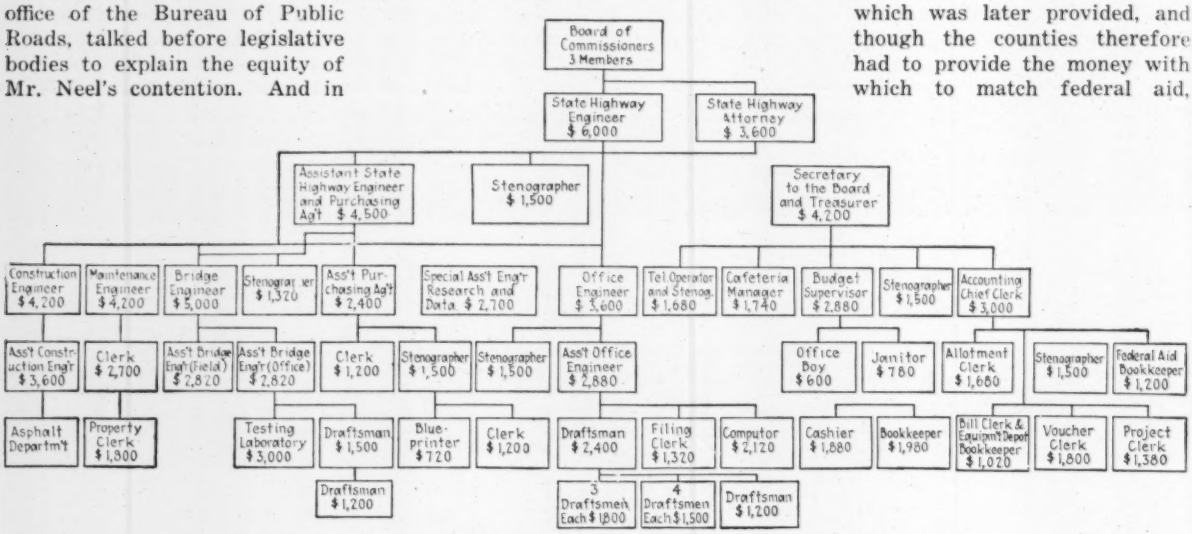
Section 3. Be it further enacted by the authority aforesaid, That all laws and parts of laws in conflict with this Act are hereby repealed.

Approved August 16, 1916.

The Prison Commission was designated because it had charge of convict labor, and could offer assistance to road construction in furnishing the large share of the labor. Incidentally convict labor is used extensively on county road work all over the state even now. The Prison Commission was also a strong political body and was favored as the administrator of the federal funds and carrying out of the new functions. This highway department functioned for three years, until the passage of the existing highway law, which, however, has been somewhat amended since its original passage in 1919.

Pursuant to the provisions of the 1916 act authorizing the hiring of needed engineers, Mr. Neel, who had been driven from a private engineering practice out of Tampico, Mexico, by the revolution, was put in charge of state highway engineering. Two other engineers were appointed to assist him, and with that force and the hiring from time to time of private engineering service, the first state roads were built. No funds were forthcoming from the state for the payment of engineering supervision although a small legislative appropriation was made in 1916 for the actual administration of federal-aid funds. The engineers were dependent upon the counties for the services rendered.

Private firms were at times employed at an agreed schedule of fees which was to include surveys, plans and supervision. There was no actual supervision of such work by the state. Mr. Neel served practically without compensation until the legislature of 1918 passed an appropriation of $25,000 for engineers' salaries since the inception of the department. During this time all of the match money for federal aid was being raised by the counties, and spent more than less where the counties designated. During that time, also, Mr. Neel had been active in his determination that Georgia should have a fully organized and equipped state highway department that should be free of politics and should function free of county control. Finally, a special committee of the legislature was appointed to study the situation. E. W. James, of the Washington office of the Bureau of Public Roads, talked before legislative bodies to explain the equity of Mr. Neel's contention. And in August, 1919, the law under which the department now functions was written.


Board of Commissioners 3 Members
State Highway Engineer $ 6,000
State Highway Attorney $ 3,600
Assistant State Highway Engineer and Purchasing Ag't $ 4,500
Stenographer $ 1,500
Secretary to the Board and Treasurer $ 4,200
Construction Engineer $ 4,200
Maintenance Engineer $ 4,200
Bridge Engineer $ 5,000
Stenographer $ 1,320
Ass't Purchasing Ag't $ 2,400
Special Ass't Eng'r Research and Data $ 2,700
Office Engineer $ 3,600
Tel. Operator and Stenog. $ 1,680
Cafeteria Manager $ 1,740
Budget Supervisor $ 2,880
Stenographer $ 1,500
Accounting Chief Clerk $ 3,000
Ass't Construction Eng'r $ 3,600
Clerk $ 2,700
Ass't Bridge Eng'r (Field) $ 2,820
Ass't Bridge Eng'r (Office) $ 2,820
Clerk $ 1,200
Stenographer $ 1,500
Stenographer $ 1,500
Ass't Office Engineer $ 2,880
Office Boy $ 600
Janitor $ 780
Allotment Clerk $ 1,680
Stenographer $ 1,500
Federal Aid Bookkeeper $ 1,200
Asphalt Departm't
Property Clerk $ 1,800
Testing Laboratory $ 3,000
Draftsman $ 1,500
Blue-printer $ 720
Clerk $ 1,200
Draftsman $ 2,400
Filing Clerk $ 1,320
Computor $ 2,120
Cashier $ 1,680
Bookkeeper $ 1,980
Bill Clerk & Equipm't Depot Bookkeeper $ 1,020
Voucher Clerk $ 1,800
Project Clerk $ 1,380
Draftsman $ 1,200
3 Draftsmen Each $ 1,800
4 Draftsmen Each $ 1,500
Draftsman $ 1,200

ORGANIZATION OF STATE HIGHWAY DEPARTMENT IN GEORGIA

As now constituted the highway department consists in a three-man board, the highway engineer and his engineering staff. The three members of the highway board are appointed by the governor for six-year terms. The original board was so appointed that one new appointment should be made every two years thereafter. Recently the law has been amended so that the chairman of the board, appointed and designated by the governor as such, is to be a paid officer who shall devote all of his time to the administration of the board's affairs. Thus there is a chief highway commissioner, a paid executive. The state highway engineer is appointed by the highway board and he holds office at that body's pleasure. He may be discharged "with or without cause." The state highway engineer has the authority of appointment, with the approval of the board, of all his engineering staff.

State Highway System—The 1919 law also designated a state system, to be known as the state-aid road system. That part of the law referring to such designation is given below:

> That there is hereby created a system of state-aid roads in this state for the purpose of interconnecting the several county seats of the state, which shall be designated, constructed, improved and maintained by the State Highway Department and the provisions of law, and that the term state-aid roads shall include the state or interstate bridge or other subsidiary structures necessary or desirable in the construction of said road.
>
> That there is hereby created a state-aid road fund to be controlled and expended by the State Highway Board as herein provided for, and that said fund shall consist of such moneys as are provided for herein, and as may from time to time be appropriated or provided for road or highway work by the state of Georgia, or from other sources.
>
> That all funds realized from motor vehicle licenses or fees under present or future laws, less the expense of collecting the same, as provided by law, shall be deposited as part of the state-aid road fund hereinbefore created, and said funds shall be controlled and disbursed under the provisions of this act.

Though the State Highway Department was not authorized to use the motor vehicle money on new construction, but must reserve it for maintenance, which was later provided, and though the counties therefore had to provide the money with which to match federal aid, practically no strings were put upon the use of the county money, except that the act provided that "two county seat roads, starting from the county seat, shall be so designated in each county; said roads to traverse the county to the county line and to connect with the state-aid roads of any adjoining county or counties." Further, the highway department was specifically given the power to "have charge and control of all road or highway work designated or provided for, or done by the state or upon state-aid roads; to designate, improve, supervise, construct and maintain a system of state-aid roads, provided that no road shall become part of said system until the same shall be so designated by the State Highway Board by written notice to the county road authorities concerned; to have charge, control, supervision and expenditure of all funds now or hereafter appropriated or provided for highway or road work by the state or which may be part of the state-aid road fund. . . ." Thus it is that in the original bill all authority for disbursement of funds and designation of routes lies with a state authority. It is apparent that the state made great strides toward the acquisition of an interconnected system by those provisions of its highway law. It is remarkable that with such complete reliance for funds upon the counties, such legislation was enacted.

With motor vehicle license money limited to maintenance uses alone, the state had no construction funds

of its own save those from federal aid. The 1915 legislature passed an act levying a ½c. tax on gasoline, to be used for actual inspection of gasoline and fuel oil.

In 1920 a 1c. fuel oil tax was put on for the purpose of replacing an annual income into the general treasury of approximately $500,000, which the state received from the lease of a state-owned railroad, which income had been hypothecated for a period of five years to meet a deficit in the state treasury. After the five years period, ending December, 1926, during which the law stipulated that the income from this 1c. gas tax, amounting to more than a million dollars annually, must go into the general fund, the proceeds of this 1c. tax will be turned over to the highway department.

In 1922 the legislature placed an additional fuel oil tax of 2c. upon the statute books, 1c. of which went to the counties for their use on roads in general and the other cent to the state highway department for use in constructing the state-aid roads. The total tax levied by these acts was 3½ cents. In 1925 the legislature voted an additional ½c. fuel oil tax to the state highway department, making a total of 4c., ½c., to the agricultural department for the inspection of fuel oils, 1c. to the counties for roads and 2½c. to the state highway department for state aid roads, 1c. of this 2½c. being available for state-aid roads, as stated above, after December, 1926. Assuming, then, that the gasoline tax will not be changed and that federal aid will not be withdrawn, the state will have close to $6,000,000 to spend next year on new construction, and an increasing amount thereafter, plus contributions by the counties.

Maintenance Patrol System—Inasmuch as so little money has been available in the past for new construction, and because the use of motor vehicle license fees was limited, maintenance has been one of the chief considerations of the state highway department. A maintenance department fully organized and equipped with motorized equipment has been built up so that every mile of the state system is kept in condition. The system of maintenance is largely patrol. All of the work is done directly under the supervision of the nine division engineers. There is a maintenance engineer in each division office and under him supervisors who actually control the patrolmen. Each patrolman is given an average of about 25 miles to cover. Where the traffic is heavy sub-patrol districts are created, and these outfits concentrate on a few miles of road. Each patrol is equipped with road machines, trucks, tractors, drags, etc. Because of the extensive use of motor equipment patrolmen are picked first because they are mechanics. They are then trained in grading, shaping, and other maintenance duties. The theory is that it is easier to train a mechanic how to maintain a road than it is to instruct a good patrolman in operation and care of motor equipment. Mechanical experts are sent out over the patrol districts to instruct the patrolmen in the proper use of their equipment and there is a careful check to see that they heed their instruction.

In addition to the patrol outfits heavier outfits are kept at each division headquarters for extraordinary repairs. Also what are called reconstruction outfits are stationed at division headquarters and put on small sections where roads are found to be impassable. Their equipment consists principally of 10- and 5-ton tractors, graders, scarifiers, and heavy rollers. The motorized maintenance equipment is valued at $1,000,000.

Because, mainly, the department is new, accurate performance records are kept of each piece of motor equipment. It serves as an excellent guide to the purchase of equipment when replacements become necessary. Cost of oil, gasoline and grease, repairs in and out of the shop and operation are tabulated for each tractor, for instance, both for wet and dry weather and for heavy or light work. Mr. Neel was able to convince one of the best known tractor manufacturers only recently why he should give a competitor some of the business. The cost records were irrefutable. One of the bits of information derived from cost records is that trucks are found to be less costly and more efficient in doing light pulling than are tractors. Such work as pulling graders is therefore done with trucks.

Methods Adapted to Local Conditions—The original state highway system comprised 4,800 miles. That has been added to until now the total mileage is 6,242. All of this is under maintenance, 2,648 miles are improved and 986 miles are paved. This paved mileage, however, includes semi-hard and hard types, the former built of gravel, chert, etc., totalling 545 miles, and the hard surfacing 441 miles. The hard surfacing is mainly asphalt types and concrete.

Of the unpaved though improved roads by far the greatest mileage is represented in top-soil and sand-clay roads. These types differ little, the character of material used being the principal difference. Largely because of the lack of money for hard pavements the state highway department has made an intensive study of the use of roadside materials.

A soil expert is kept continuously employed studying local materials and their availability for various kinds of road work. It has been discovered, for instance, that a very good road can be built from a local material that is essentially pebbly gravel with a high iron oxide content. Mixed with the proper amount of clay it is said to make an excellent base for hard-surfacing, and it is probable that in the future development of paved roads that material will play a large part.

The top-soil roads are built of 8 in. thicknesses of selected roadside materials. Where that top-soil is a mixture of sand and clay the road becomes what is called a sand-clay road. The road is first graded and shaped and the top-soil spread and allowed to consolidate under traffic. Mr. Neel believes that with proper care such a road can be spread with a 3-in. layer of gravel, left open to traffic for about six months, then scarified and reshaped, and be used as a base for any asphalt wearing surface. As a matter of fact some such roads have been built and are standing up well under a comparatively heavy traffic.

Other unusual types being experimented with include clay-bound macadam, instead of waterbound. This type of road, laid to a 6-in. depth, is found an excellent base for asphalt surfacing. There is also being built a clay-gravel road with what might be termed an asphalt top. It is more than a surface-treated road, though the top is laid as treatment is given. The road is shaped and spread with from 6 to 7 in. of compacted gravel. It is used for a year or two and then scarified and brought to a smooth surface and broomed. A half-gallon of asphalt per square yard is then put on it, and a low-penetration asphalt (penetration about 120) is used. Upon this is spread from 50 to 60 lb. per sq.yd. of stone of a maximum diameter of 1¼ in. The

road is then rolled and from 0.2 to 0.3 gal. per sq.yd. of asphalt is put upon it. The road is then covered with pea gravel or stone chips. Such a road has been carrying a traffic of about 2,000 vehicles per day for the past eight months and there has been no sign of failure, and no maintenance or patching has been necessary. The most used section of that type is laid outside of Valdosa, through which most of the tourists travel en route to Florida. Mr. Neel says that this road cannot be distinguished from a penetration macadam and it costs only from 31 to 39c. a square yard.

Because of the extensive use of top-soil roads and the probability that top-soil will be used as a base for future asphalt work, grading contracts now call for work to be done with the placement of one foot of top soil. If a road is to be graded and improved, both grading and top-soil placement are done at one time. Though the grading expense shows higher in cost, the soil, which is being excavated anyway, is placed on the road instead of going into a spoil bank or a fill, and the ultimate road improvement cost is lower.

Georgia Highway Projects—Two of the outstanding projects which the state is going to build next year, one of them only partially complete, are the paving from Atlanta to Macon and the improvement of the Coastal Highway from Savannah to the Florida state line. The former project covers 44 miles and will be concrete of 9:6:9-in. section without reinforcing and without expansion joints except at the end of a day's work. The cost will be around $1,000,000. The other project will cost in the neighborhood of $3,600,000, but only $1,100,000 will be expended during 1926. A study of local materials has been made for that job, so the type of surfacing has not yet been determined. The road is about 120 miles long and the soil is mostly alluvial. Local gravel of good grade has been discovered overlying a 10-ft. sand deposit. Also rock brought over many years ago as ballast in merchant ships has been discovered and will be crushed and used. Enough of this rock to lay 40 miles of concrete base is available and it is exceptionally hard, having a french coefficient of wear of 18. The state is committed to finish that highway in three years. It forms a link with the South Carolina system and connects with the road crossing the interstate bridge recently completed across the Savannah River at Savannah.

Though handicapped by lack of funds, and though under constant petty interference from uninformed or misinformed politicians, Mr. Neel and the highway board have built up an organization of great merit. And they have given the state all that could be expected in better transportation routes. The department owns its own building, erected from the proceeds of the sale of war equipment it got and could not use. Its mechanical shops are among the best. It has gradually been educating the people of the state that paved roads cost lots of money. It has severed itself from county control so that it now requires each county to pay at least 25 per cent of the cost of state roads in the county, and it supervises design and construction and administration of funds. But one of its biggest achievements has been the building up of an engineering organization that can be expanded with little difficulty to spend on hard pavements all the money the electors will give it. And it is believed the time of a large bond issue is not far off.

First-Story Columns Cut Away In Building Enlargement

Extension of Twelve-Story Bank Building Required Underpinning Two Columns by Girders at Second and Third Floor Levels

ARCHITECTURAL problems presented by the enlargement of the 12-story Harriman National Bank Building, in New York, made it necessary for the structural engineers to devise means by which the lower sections of two columns of the old building could be removed, if possible without disturbing their upper sections. Accordingly, girder systems resting on new columns nearby were designed to receive these two columns, one at the second-floor level and one at the third-floor level, and after they had been erected the new columns supporting them were jacked up, until the girders took the load of the old columns, and the idle lower sections of the latter were cut away. The construction work has just been carried out under plans of Weiskopf & Pickworth, structural engineers, by Post & McCord, structural steel contractors.

In the plan sketch, Fig. 1, the changes made in extending the building are indicated. The building is located at the southeast corner of Fifth Ave. and 44th St., and is being enlarged by adding a 34-ft. section to the south. The Fifth Ave. façade contains heavy stone pillars in the two lower stories, with a pilaster at each corner. To make the enlarged façade homogeneous it was necessary to extend the stone pillar treatment across the full width. As this would bring the steel column at the southwest corner of the old building into the open space between pillars, the whole scheme was dependent on either removing the column in its entire height or supporting it above the architrave and cutting away its lower portion. The latter course was adopted. A similar problem arose in the case of the side-wall column two bays back of this corner, due to architects' plan to extend the banking room on the ground floor into the new part of the building, which extension made the presence of this particular column undesirable. A similar system of girder support was resorted to as in the other case, with minor differences in plan and execution.

To support the corner column (column 17) a deep double-web plate girder extending forward from the column next back is connected to the sides of the corner column by deep gusset plates occupying a large part of the third story height (Fig. 3); just behind the corner column this girder is supported by a pair of transverse girders carried at one end on a new column

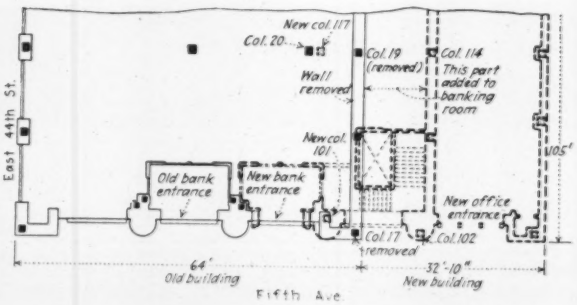


FIG. 1—EXTENSION OF HARRIMAN BANK AND NECESSARY SHIFT OF COLUMNS

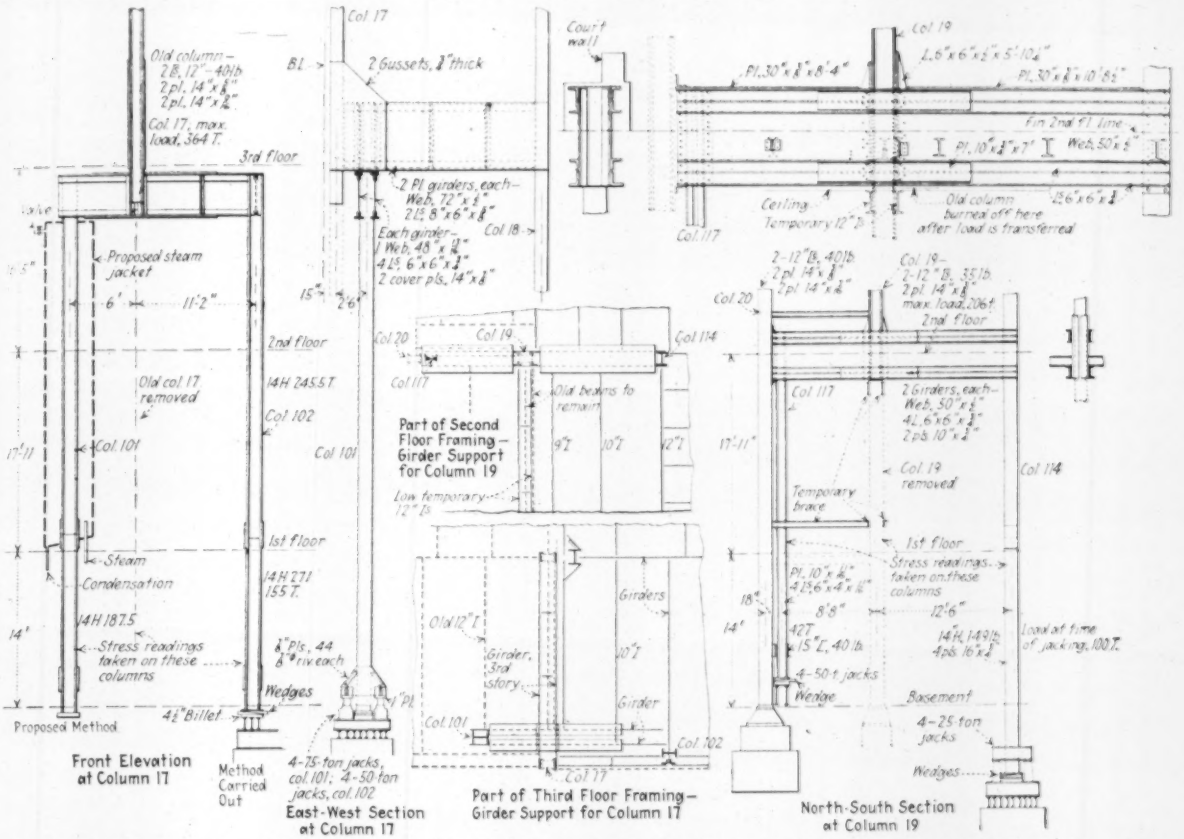


FIG. 2—GIRDER SUPPORT OF TWO COLUMNS OF OLD BUILDING, AND ARRANGEMENT FOR TRANSFERRING LOAD

built into the front wall of the old building and at the other end riveted to a floor girder of the new third-floor framing. The arrangement is shown more fully in Fig. 2; its details were determined by the necessities of the column locations.

It should be remarked that the stone pillars of the old façade contain no steel, but are themselves load-bearing, whereas those of the new façade are hollow and contain each a steel column which carries the wall framework above. This accounts for the lack of alignment of the two front columns carrying the girder system described. However, the resulting location of the front girder behind the old column instead of central with it was a distinct advantage, as it permitted placing the entire new supporting system without disturbing the lower section of column 17.

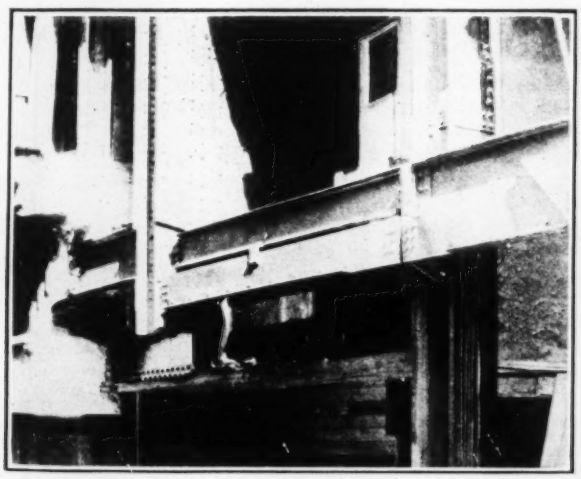


FIG. 3—DEEP CANTILEVER GIRDER IN THIRD STORY CARRYING OLD COLUMN

At the side-wall column (column 19), the new supporting girder is directly on the line of the column. It is carried at its north end by a short-length new column, as the existing column at this location was not strong enough to carry the extra load; the new column rests on a footing girder which spans the foundation pedestal of the old column and is supported on new pedestals alongside.

Proposed Lifting Method—In their plans for the work the engineers indicated an ingenious method of transferring the load and releasing the old column by utilizing the expansion of steel when heated. They also required the contractor to make strain-gage measurements on the old and new columns during the transfer, to verify the release of load from the old column before cutting it off.

As applied to the case of the corner column the proposed thermal method of lifting is sketched in the elevation in Fig. 2 by dotted lines. The new columns supporting the girder system (columns 101 and 102) were to be enclosed in steam jackets extending from first to third-floor levels, these jackets to be made of boards, building paper on a wire mesh frame or any desired material suitable for the service; and steam at atmospheric pressure was to be supplied to each jacket by one pipe and the condensate drawn off by another. The steam would heat the column, and the expansion due to this heating would raise the girder system, previously wedged to tight bearing, sufficiently to lift the

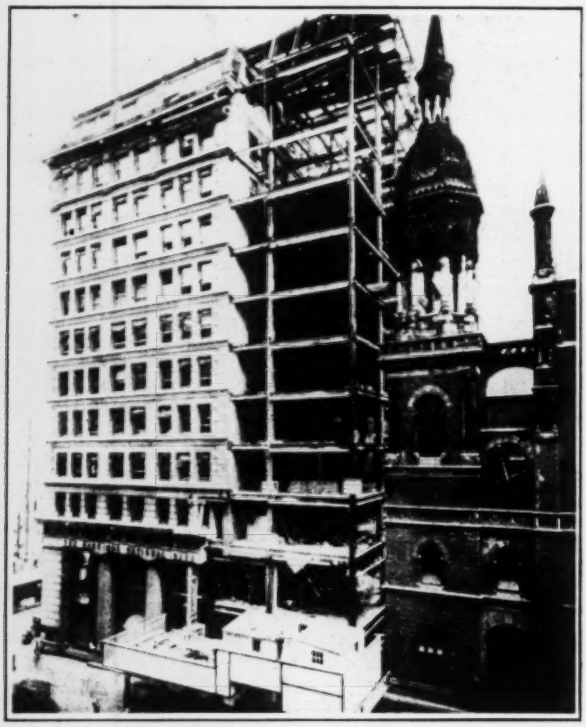


FIG. 4—ENLARGEMENT OF HARRIMAN BANK BUILDING—DURING COURSE OF WORK AND AFTER COMPLETION

old column and release the load on its lower section. After cutting off the lower section the columns would be allowed to cool and the structure would be in final condition.

The contractor preferred to make the load transfer by jacking, however. Previous experience of his working forces in jacking up columns had made them familiar with the handling of jacks, and as the same methods were used in this case they would be able to carry through the operation smoothly and without the delays that are apt to occur when a new method is used. This choice was satisfactory to the engineers and was followed, retaining the plan of checking the load transfer by strain-gage measurements.

No troubles were encountered in erecting the new column-and-girder systems. The main girders, which attach to columns 17 and 19 directly, were connected to these columns under a carefully devised procedure, to assure maintaining sufficient bond between the component parts of the columns at all times.

The deep cantilever girder at column 17 is composed of two built channels, connected by top and bottom batten-plates at intervals. The gusset plates at its forward end fit against the cover-plates of column 17, which is of double-channel box type. To prepare the column to receive these gussets the cover-plate rivets had to be removed. To this end, every third rivet was knocked out and replaced by a countersunk rivet. Then the intermediate rivets were knocked out, and the countersunk rivets at about 9 in. spacing were depended upon to hold the four parts of the column together temporarily. The blank ends of the gussets were next marked and drilled to match the intermediate holes, and the connection was riveted. At column 19 the procedure was substantially the same.

TABLE I—STRESS READINGS AT COLUMN 17

Col.	Face	Strain-gage Readings: Before Jacking	After First Jacking*	After Second Jacking†	After Third Jacking‡	On Following Day	After Cutting Lower Column	Dead-Load in Column, Lb.	Stress Change Lb. per Sq.In.: 1st to 4th Readings	1st to 6th Readings
101	N	118	80	85	70	82	73	370,000	+6,300	+5,900
(69.45	E	135	103	105	94	105	94	(5,330 lb.		
sq.in.)	S	57	28	28	20	34	25	per sq.in.)		
	N	40	40	...	40	42	70			
17	E	114	111	114	112	117	152	500,000	.....	—4,275
(77.77	S	104	110	...	104	105	135	(6,430 lb.		
sq.in.)	W	17	20	...	20	20	32	per sq.in.)		
102	N	38	25	25	20	28	26	208,000	+3,400	+3,200
(71.94	E	82	65	63	58	70	57	(2,890 lb.		
sq.in.)	S	68	48	44	42	50	41	per sq.in.)		

* Av. lift 0.017 in. † Av. lift 0.22 in. ‡ Av. lift 0.15 in.

1 unit = length change of 0.00006 in. in 12 in. = 0.000005 in. per in., equivalent to change in stress of 150 lb. per sq.in.

Figures below column numbers are areas of cross-section in the first story.

All gage lines were 4 ft. above first floor except those on north and west faces of column 17, which were just below second floor.

Column 17 settled $\frac{1}{32}$ in. at third floor level when lower section was burned off.

TABLE II—STRESS READINGS AT COLUMN 19

Col.	Face or Flange	Before Jacking	After First Jacking*	After Second Jacking†	Wedges Driven and Jacks Released	On Following Day	After Removing Lower Column	Dead Load in Column, Lb.	Stress Change, 1st to 4th Readings, Lb. per Sq.In.	Stress Remaining After Releasing Jacks
117	NE flange	122	77	70	71	73	...	164,000	+6,150	+6,150
32.47	E	117	78	65	74	73	...	(5,050 lb.		
sq.in.)	SW flange	52	23	20	23	20	...	per sq.in.)		
	N	38	75	95	84	85	85			
19	E	43	79	97	94	93	93	276,000	—7,275	+1,625
(31.08	S	49	88	104	97	103	83	(8,900 lb.		
sq.in.)	W	21	57	76	70	68	70	per sq.in.)		
114	E	103	88	90	88	85	67	112,000	+2,100	+2,100
(91.50	S	118	102	100	101	108	85	(1,225 lb.		
sq.in.)	W	62	50	49	52	45	25	per sq.in.)		

* Average lift 0.23 in. †Average lift 0.17 in.

1 unit = length change of 0.00006 in. in 12 in. = 0.000005 in. per in., equivalent to change in stress of 150 lb. per sq.in.

Figures below column numbers are areas of cross-section in first story.

All gage lines were 4 ft. above first floor.

Transferring the Column Load—The load on the corner column was about 250 tons. Four hydraulic jacks were placed under each of the columns supporting the girder system. Jacking was started, and simultaneously levels were taken on the upper section of the old column and strain-gage readings were taken on the lower sections of the old and of the new columns, measuring a gage-line on the middle of each face. The total jacking lift was about ½ in., which lifted the upper section of the old column ⅛ in. Table I herewith gives the strain-gage readings. It will be seen that the load taken by the new columns increased consistently, but that the load of the old column apparently did not decrease. The readings on the old column were less dependable because they were not all taken at the same cross-section, but in view of the perceptible lifting of the old column it was not thought desirable to lift the corner of the building any further. The old column was therefore cut at this stage.

Cutting was done with an oxyacetylene torch, making downward diagonal cuts on the two sides converging toward the middle line of the column. In this process the lift of the upper section slowly decreased by 3/32 in., indicating a gradual crushing of the uncut core of the old column. With completion of the torch cut the column was released without incident.

More consistent strain-gage results were obtained in lifting the side-wall column, which carried a smaller load (about 140 tons) but otherwise was subject to the same conditions. The results are given in Table II.

G. A. and H. Boehm are the architects for the Harriman National Bank extension. Emil Diebitsch is general contractor for the construction work.

Arch Dam Repaired by Fills Above and Below Structure

Repair Methods on Colorado Dam Designed to Reduce Water Seepage and to Relieve Thrust Forces on the Arch

By John E. Field
Consulting Engineer, Denver, Colo.

About a year ago the writer was called to examine and report on a concrete arch dam some 50 ft. in height and 300 ft. in span for the city of Manitou, Colo. The examination and analysis revealed that a large part of the forces were taken care of by arch action, that the character of the concrete was very poor, and that there was, theoretically, danger of collapse. Furthermore, on the lower side considerable disintegration had taken place caused by seepage through the concrete and by the freezing of the saturated concrete which had been exposed to temperatures as low as —30 deg. F.

The dam was of concrete, in which were embedded large pieces of granite secured from a quarry which had been opened adjacent to the dam. The mortar was made of one part cement and three parts disintegrated granite "sand." This sand was unwashed, contained much mica and all the granitic elements found in granite when disintegrated *in situ*. The cement had been tested in laboratories in Denver and found good, but no tests were made of mortar or concrete made with the "sand" used on the work. Such tests were made, however, when the methods of repair were being considered, with the result that the mortar was found to be very harsh and hard to work, that unless thoroughly washed it lacked in strength, and that the grains had well developed cleavage planes and could be broken apart with the fingers. The sand contained some easily soluble materials. There was no lime content in this sand, and some of the deposit formed on the lower face of the dam may have been due to these solubles. An analysis of the cement mortar taken from the old structure showed as near as determinable that the full proportion of cement had been put in the mortar. The

FIG. 1—PART OF LOWER FACE OF DAM BEFORE REPAIR

water in the reservoir is unusually pure, being from melting snow and running for not more than three miles over granite before reaching the reservoir. Two outstanding faults in construction are obvious—the use of disintegrated granite as sand and poor workmanship in mixing and placing. As in the case of the Gem Lake Dam, there was a heavy deposit—in places one-half inch thick—of calcareous matter on the lower face of this dam.

Methods of Repair Considered—Numerous methods of repair were considered including covering the upper or lower faces with concrete, or both, placing concrete on the lower side and converting the arch dam to a gravity section and waterproofing the upper face. Many objections and uncertainties developed in the consideration of these alternatives, and on all the cost was considerable. The difficulties anticipated were in securing a bond such as would make the old and new

concrete, even approximately, a monolith. Anchor bolts from the old to the new, while they might hold the concrete together, could not and would not eliminate a quite definite plane of separation in which water would accumulate, throwing full hydrostatic pressures on the two or three parts of the cross-section of the dam, and this water though only a film might freeze.

It was proposed also to apply waterproofing to the upper face, but the face of the dam was so weak in tensile strength that although the waterproofing might adhere strongly to the old surface, the old surface itself might give way. Guniting the surface was considered, but it appeared to be necessary in that case to anchor the wire mesh strongly to the old concrete by bolts placed deeply and close together, involving a con-

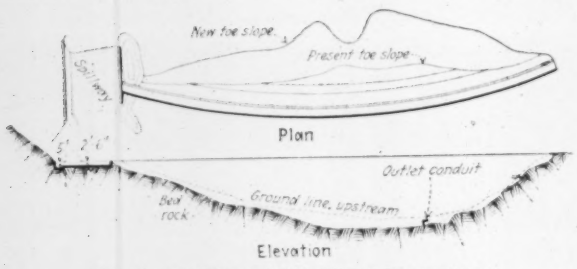


FIG. 2—PLAN OF DAM WITH TWO FILLS

siderable cost. Washing the upper surface with sodium silicate was considered, as were also washes of soap, alum, and various patented washes and surfacings. In the latter the manufacturers seemed either uncertain of the final result or were unwilling to give proper guarantees of effectiveness.

Repair Operations—The final plans called for a partial fill of earth on the upper side and a backing on the lower side to the full height of the dam, also for digging out the construction joints in the concrete. In considering the problem and the financial ability of Manitou to meet the cost, it was concluded to stop the resulting damage from seepage rather than to stop the seepage itself, although there were some precautions taken. In protecting the upper face and in placing the upper earth slope, by far the greater part of the seepage will disappear. The total seepage through and under the dam was less than $\frac{1}{10}$ sec.-ft. The seepage through the dam was about $\frac{1}{20}$ sec.-ft.

In nearly all the construction joints clay, trash, and laitance had been allowed to remain and along these joints considerable seepage occurred. These joints were dug out a maximum of 2 ft. and a minimum of 6 in. and refilled and pointed up with a 1:2 mixture of cement and clean sound quartz sand. The sand and cement were hauled five and ten miles respectively, the increase in elevation being about 2,000 ft. Over the pointed joints and upper face a plaster coat of cement mortar was placed after thoroughly cleaning, brushing, and washing the old surfaces. It is probable that this plaster coat will give way and scale off in places, but at the refilled joints it will hold. On the upper side of the dam an earth fill was placed on a 2:1 slope and extended to an elevation 20 ft. below the crest; that portion of the plastered surface below this fill will probably hold. This fill was composed of selected material—fine clay and silt—and was intended to seal some small leaks under the base of the dam. These leaks, however, were in the main due to percolation through the seams in the bedrock. On the lower side a disintegrated granite material was placed on the natural slope of 1½:1, with a 6-ft. crown at the top. This material was end-dumped from cars carried on tracks along the crest of the fill as it was completed. Most of the coarse material naturally rolled to the bottom and some lodged against the concrete, resulting in a more open porous condition at the bottom of the fill and along the contact between the old and new work, giving excellent drainage for any water seeping through the old structure. The material was obtained from borrow pits 300 ft. distant from the north end of the dam, the average haul being about 600 ft. The pits were from 25 to 50 ft. above crest elevation and were first plowed and then the material was carried to a trap over a small storage bin whence the 1-cu.yd. mine cars were loaded and pushed by hand to the place of dumping on the fill. The equipment consisted of two cars, three two-horse Fresno scrapers and a plow. One extra team was held in reserve and one team and wagon brought camp supplies. Three men handled cars, four the scraper teams and plow. These with a cook and foreman constituted the personnel on the job. The work began on Oct. 12, 1924, and ended Jan. 10, 1925.

Review of Results—The repair work was undertaken with two objects in mind: first, to relieve the thrust on the arch haunches; second, and more important, to prevent freezing on the lower face. At the high water line the earth blanket is 15 ft. in thickness from surface of earth fill to surface of concrete, an amount ample to prevent freezing even with temperatures such as occur at a 9,000-ft. elevation. The material used in fill is so porous that any seepage through the concrete will pass quite freely down the lower concrete face to the bottom of the fill where it is free to pass outward to the creek bed below. The repairs have now been completed about a year and have proved very satisfactory, notwithstanding the fact that the reservoir remained practically

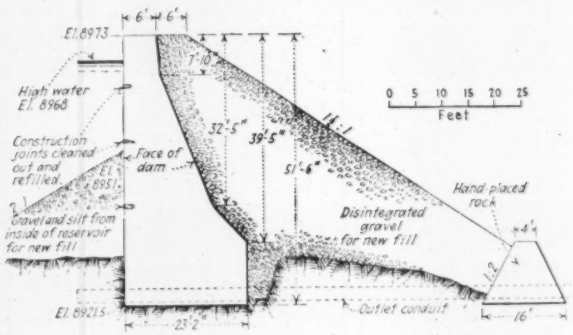


FIG. 3—CROSS-SECTION OF REPAIRED DAM

empty until about Aug. 1 of this year, since which time it has filled.

An analysis of the forces acting in the repaired structure showed that the resultant, with reservoir empty, fell within the middle third of the concrete section, and that the resultant forces with the reservoir full passed well within the lower toe of the concrete.

It is obvious from this experience and from the experience at the Gem Lake dam in California, that, where low temperatures occur, special provision must be made in masonry dams of thin section to prevent the disintegration of the concrete or masonry through freezing. This makes it incumbent on engineers and contractors to see to it that the concrete in such structures is made more than ordinarily impervious to water.

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our representative Small Cities

CENTRAL FIRE STATION, PORTLAND, ME.

Portland, Maine

LARGEST CITY IN MAINE, county seat of Cumberland County. Portland is situated on Casco Bay, has a fine harbor and is a port for many steamship lines. There is a belt steam railroad around the city and also a marginal street on the water front. The city and the many adjacent islands of the Maine coast make popular summer resorts. The city is proud of a million-dollar bridge recently built. Portland has been a commercial center since early days, first chiefly in fishing interests. It exports live-stock and grain. Its main products are lumber, structural iron, stoneware, elevators, printers' machinery, gas and marine engines, boilers, furniture, stoves, paints, and shoes and clothing. Settled 1632 as Casco Neck; in 1658 called Falmouth; twice destroyed by Indians; in 1786 incorporated under the name Portland. Pop. (1920) 70,000.

INADEQUATELY providing for engineering personnel appears to be one of the chief sins of omission committed by the municipalities. In the numerous cities studied in this series prosecution of public works construction is very often a one-man job. Therefore, when one visits Portland and finds an office and field force numbering about 25 men, and also discovers that each major branch of engineering work is directly controlled by an assistant engineer responsible to the director of all city engineering work, the Commissioner of Public Works, the city at once assumes a place of honor for recognizing the need for adequate technical personnel. And this large force is maintained throughout most of the year.

Portland is a commission-manager city. All engineering functions repose in the Department of Public Works. This department is organized into the committee on streets and public works, city-manager, commissioner of public works and city engineer, secretary, superintendent, division of surveys and plans, division of sewer construction and maintenance, division of street and sidewalk construction and maintenance, and division of bridges, wharves and ferries, each one of the last four-named divisions being directly supervised by a division engineer. The commissioner of public works and city engineer, Edward M. Hunt, therefore has direct control over all design, construction and maintenance of all engineering save water supply. His division engineers are young men but of sound judgment and ripe experience.

The city lies mostly in the heel and toe of a peninsula bounded by Back Cove on the north, Casco Bay on the east and the Fore River on the South. The broken shore line and the uneven topography make the street layout irregular. The irregularity of topography, however, makes of sewage disposal an easy matter, by gravity. Crushed stone is locally available which makes construction of concrete roads or crushed stone roads possible at about the smallest expense. As a matter of fact, the city maintains a large stone crushing plant within the city limits and is able to crush stone for a price of about $2 a ton loaded on trucks at the crusher. During 1924 a total of 13,000 tons were crushed and delivered. It is probable that close to 20,000 tons will be used from the city's plant during 1925 because a larger crusher has been installed. The stone is granite and lies upon an 18-acre tract near one of the arterial roads.

Portland is probably unique among cities in its possession and administration of a number of islands that lie seaward. There are seven of these islands upon four of which the city maintains streets. A sewerage system has been installed and maintained on Peak's Island, the largeset one, and Diamond and Peak's Islands are supplied with city water by a main laid under Casco Bay.

As is the case with so many smaller cities the engineering force in Portland is concerned principally with design, construction and maintenance of highways and sewers. There are about 150 miles of highways inside the city limits, one-third of which mileage is paved. The paved streets are of two types—penetration macadam for light though intensive traffic, and granite block on concrete or gravel base and grouted or sand-filled, for heavy traffic. The granite block paving in Portland, incidentally, is perhaps the best heavy-duty paving observed in any city yet visited.

Granite Block—Granite block is either entirely new blocks or old blocks which are split and redressed. In constructing a street out of the old block, half of the street is reconstructed at a time, that is, the block is taken up, split and relaid before the other side is touched. The old block, a great deal of which is being taken up and relaid after being split, was originally laid about 30 years ago.

In relaying split block, which when split is about 5 to 8 in. long, 3½ to 4½ in. wide, and 4 to 5 in. deep, it is laid on a 6-in. concrete base and a 1- to 2-in. sand cushion. It is grouted with a 1:1 portland cement grout. The joints are first filled and then broomed over. After the clean grout has been broomed over the surface the road is left 10 to 20 min. and then watered and the surplus grout is broomed off. The paving is again sprinkled and the brooms are then drawn across and out of the section being grouted. This has effectively prevented any checking at the joints.

To prepare the subgrade for laying the block, it is necessary to remove from 4 to 5 in. of waste material under the old block section and 12 in. under the new block section. Cost of this paving including new granite blocks, is about $6 a square yard. Recent contracts were let at $3.06 a square yard with the blocks furnished by the city. The cost of the blocks is about $2.70 a yard for new block. The cost of split block paving has been about $3.50 a square yard which type includes the taking up of the old block, splitting it and redressing it, laying it and finishing the pavement. The city has also done considerable work of the sort for the street railway company. Construction is practically the same; the block is taken up from its

3-in. concrete base and relaid on a 4-in. base after the blocks are wire brushed.

Considerable pains are taken to guard against having pavement of this sort opened up for subsurface installations. No opening of the new pavement is allowed within five years except under the direst emergencies, which do exist at times. In making subsurface installation the pavement opener is charged $4 a square yard for the area disturbed in bitulithic, brick or wood block pavement, and $2.50 per square yard for all other pavements. After the backfill has settled the department of public works relays the pavement. There is no charge for opening dirt or unimproved roads.

Since the highway mileage of Portland is considerable there are numerous earth roads. They are treated as follows: First, the road is shaped with a scraper and a priming coat of liquid asphalt applied. The first application is of 45 per cent asphalt and in the amount of ½ gal. to a square yard. Sand is then spread where necessary to take up excess oil, but the initial coat is allowed to be absorbed by the earth if it is possible. Traffic is put on the road immediately. As soon thereafter as the road has sufficiently dried out another application of one-quarter to one-half gallon per square yard of 65 per cent asphaltic oil is applied. Sand is then generally spread and traffic allowed on the road again immediately. If it is discovered necessary, half of the road is oiled at a time. The sand is stockpiled along the roadside so that shovelers can easily handle it to the road. If heavy traffic is anticipated two or three inches of crushed stone is spread and rolled and treated with oil the same as an earth surface. The oil treatment forms a carpet of asphalt and sand, which protects the road from wear and the action of water.

Penetration Work—Penetration macadam laid in the city is one-course work. The subgrade is first excavated and upon it is placed crushed stone. The stone is then rolled to a thickness of 6 in. and this penetrated with 1½ to 1¾ gal. of asphalt binder of a penetration of 85 to 100. Pressure machines apply the binder. After penetration the surface is lightly covered with pea stone and rolled. Any surplus pea stone is swept off and a seal coat is put on. The seal coat is of the same asphalt as the binder and the application is ½ to ¾ gal. per square yard. Pea stone is again spread and the entire road rolled. This class of work is done with city forces and costs about $2 a yard.

It is interesting to note that in connection with grouting of stone-block paving, the city has tried quick-hardening cement. Ordinarily after stone block is grouted and the grout brushed, allowed slightly to harden, wetted and then brushed again, it is usually closed to traffic for a period of 9 days. With the use of quick-setting cement grout the street was opened 36 hours after completion of the job. Just what the city engineering department thinks of quick-setting cement under such uses is as yet unknown.

Sidewalk construction presents a unique situation. The city pays all the cost of street paving from the general tax. The law provides, however, that one-half the cost of paving sidewalks shall be assessed upon the abutting property. The law further provides that the cost shall be divided as follows: The owner of the abutting property furnishes the granite curbstone, and the city furnishes the bricks. The city then sets the curbstone and lays the bricks and assesses a portion of the cost of the work upon the abutting property. In the case of cement concrete sidewalk, the abutting owner hires a private contractor to lay the walk according to line and grade fixed by the city. The owner then pays the contractor, and the city pays the owner a rebate of 62½ cents per square yard. Brick is laid by the public works department but cement always by private contractor. Granite curbing is used throughout because of the proximity of the city to granite quarries and the excessive frost penetration which at times attains a depth of 5 ft.

The water-works of Portland are owned by the public but not run by the city. There exists the Portland Water District which is composed of Portland proper and South Portland across the bay. The district's affairs are administered by a board of five trustees, four of whom are selected from Portland and one from South Portland. These five trustees have absolute control. They are elected, one each year, for five-year terms. These trustees engage the necessary engineering services for the water-works. The water supply comes from Sebago Lake, about 16 miles from Portland. It is a gravity supply from a 20-m.g. reservoir. No treatment except chlorination is given it.

The sewerage system is principally a combined one, for disposing of both sanitary sewage and storm water through the same channels. In a small part of the city the sewers were designed to dispose of sanitary sewage only, but these small sewers are being replaced by larger ones.

A unique feature of the Portland highway system is the state aid which is given certain arterial routes. The state law allows a maximum of $15,000 aid to the city. It must be matched dollar for dollar by the city. There is a provision in the law whereby, if the money is available in the state highway treasury, the city can make a request for five times the $15,000 appropriation if it matches that same amount. This makes available a maximum of $165,000 yearly for a single street more than half of which amount is provided by state-aid funds. The effect of this has been to build up with enduring paving types the principal arterial highways in the city limits.

Engineering Work

Salt Water in Fire Mains Speeds Corrosion

An appropriation of $26,000 has recently been made by the San Francisco board of supervisors to pay for fresh water to be used in the city's high pressure fire protection system. For nearly two years now this system has been supplied with water pumped from San Francisco Bay. The appropriation will pay for fresh water used at fires and lost in leakage during a period of about ten months. The change to fresh water was decided upon when it was shown that in the last two years leakage from the high pressure system has increased from 125,000 to 225,000 gal. daily. This loss is ascribed to deterioration of the pipes due to accelerated corrosion and electrolysis resulting from the salt water. The high pressure system was built in 1912 and was provided with connections so that in any emergency bay water could be used. Only fresh water had been allowed to stand in the system, however, until two years ago.

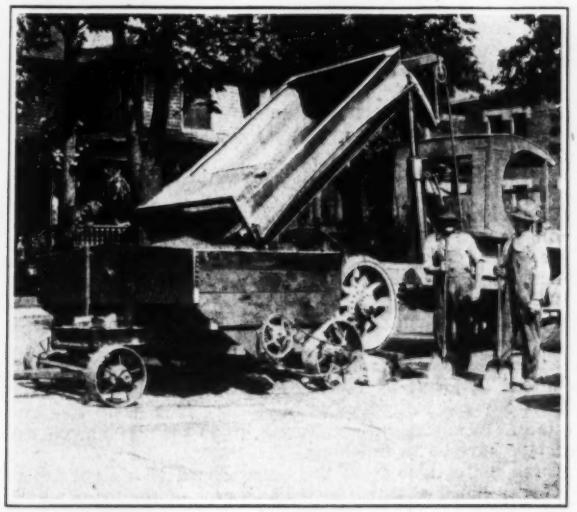
Of the Small City

City Must Pay Damages for Fixing Building Line

DAMAGES were awarded in the Superior Court of New Haven, Conn., against the city of New Haven in a suit for damages by a property owner affected by a recent order of the Building Line Commission which established the building line on a certain street 18 ft. back of the property line. The case is of special interest because it is the first case since the establishment of the commission, nearly 15 years ago, where an order of the commission was appealed to court. In its previous practice the commission has made it a practice to find equal benefits and damages, so that owners received nothing.

In the present case a plot of ground 53x105 ft. at the corner of Whalley Ave. and Boulevard was involved. A building-line set-back of 10 ft. has been established on Boulevard for some time. In February, 1924, the commission established a building-line set-back of 18 ft. on Whalley Ave., a 100-ft. street. The owner of the property, Mrs. Palmer, was about to demolish a dwelling house then on the land, planning to replace it by a group of store buildings; this plan was rendered impossible by the new building-line order. She sued for damages. Two appraisers for the city and two for the owner found damages ranging from $1,666 to $1,820. One of them computed the value by area, appraising the land taken, about one-sixth of the total area of the lot, at one-sixth the valuation of the lot as a whole. Two others computed the value from a fixed frontage value, taking 20 to 22 per cent of this as the value of the front 18 ft. Another used both a rental loss method of calculation and a method based on total value and frontage with the assumption that half the value of the land between property line and building line remained with the owner. The decision of the court set the damages (in excess of benefits assessed by the commission) at $1,800, with interest from the time of the order establishing the building line.

Stone Spreader Used by City of Rockford, Ill.



FILLING HOME-MADE DEVICE FOR SURFACE TREATMENT OF MACADAM STREETS

Hopper-bottomed spreader is 8 ft. wide to cover swath of oiling machine. A slotted opening in bottom, lever controlled, drops gravel on an angle iron which scatters gravel evenly. Utilizing a 5-ton tractor and loading with truck directly more than 27,000 sq.yd. have been surface treated in an 8-hr. day.

Kentucky Health Board Rates Water Supplies

BASED on character of the raw water, methods of treatment, operation of plant and analyses of water that goes to the consumer, 30 water supplies out of 91 plants inspected by the State Board of Health in Kentucky are rated good, 28 doubtful, 29 bad and 4 no rating but probably good. The ratings are as of the dates of inspection. The report of the sanitary engineer, F. C. Dugan, lists the 91 cities under the three classes named as follows:

Good—Ashland, Clinton, Danville, Dawson Daylight Coal Co. at Dawson Springs, Earlington, Frankfort, Fulton, Georgetown, Graham, Harrodsburg, Hazard, Henderson, Hickman, Jenkins, Lexington, Louisville, Mayfield, Middlesboro, Murray, Owensboro, Paducah, Pineville, Richmond, Shelbyville, Somerset, Stearns, Sturgis, Versailles, Wayland and Winchester.

Doubtful—Barbourville, Bardstown, Bardwell, Barlow, Bowling Green, Burnside, Campbellsville, Carrollton, Catlettsburg, Corbin, Covington, Cynthiana, Dawson Springs, Eddyville, Elkton, Hopkinsville, Lawrenceburg, London, Mt. Sterling, Nicholasville, Paris, Pembroke, Russell, Scottsville, Springfield, Wickliffe, Wilmore and Wingo.

Bad—Adairville, Cadiz, Calhoun, Carlisle, Central City, Franklin, Glasgow, Greenville, Guthrie, Harlan, Hartford, Hawesville, Irvine, Kuttawa, Lancaster, Livermore, Louisa, Madisonville, Maysville, Morgantown, Newport, Pikesville, Prestonburg, Princeton, Providence, Russellville, Smith Grove, Stanford and Straight Creek.

No Rating—Elizabethtown, Falmouth, Morganfield and Williamsburg.

High Wastage of Water at Sacramento, Calif.

There has long been a provision in the city charter at Sacramento, Calif., that prohibits the installation of meters on water services to residences. A novel situation has been brought about by the fact that the citizens have always taken much pride in this provision and insist on retaining it although the city now has an elaborate and highly efficient filtration plant through which water is carefully filtered only to be wasted at a rate that puts this city among the most profligate users of water in the United States. At the recent annual convention of the California section of the American Water Works' Association it was reported that in Sacramento, which serves 85,000 water users, the minimum night flow never falls below a 12-m.g.d. rate and the average low flow is at the rate of 15 m.g.d. The average consumption for 1924 was 270 gal. per capita daily with an average for the year of 22 m.g.d. For short periods the consumption rate ranges up to 600 gal. per capita per day. This high per capita rate is attributed to leakage and to carelessness. The leakage is not believed to be in the distribution system which is comparatively new and, generally speaking, in good condition. That the loss is due chiefly to waste in household fixtures is supported by the fact that a house-to-house inspection recently undertaken showed that 98 per cent of the premises visited have leaky fixtures. The inspection and corrective measures now under way are expected to decrease the wastage 15 to 20 per cent.

Permanent Type of Railway Track Is Proposed

Reinforced-Concrete Slab Built in Place Has Steel Truss Frames Forming Longitudinal Bearings for the Rails

THAT a more permanent and substantial type of track construction is desirable for efficient and economic service under modern conditions of railway traffic, loads and maintenance, was suggested by F. H. Alfred, president (and former chief engineer) of the Pere Marquette R.R., at the 1925 meeting of the American Railway Engineering Association, as noted in *Engineering News-Record* of April 23, 1925, p. 674. He has followed up this idea by the development of the concrete and steel construction which is shown in the accompanying drawings and which is designed specially to meet the conditions noted. In a statement prepared by Mr. Alfred and Paul Chipman, office engineer of the Pere Marquette R.R., the features and purposes of the proposed track construction are explained, and an abstract of this statement is given below:

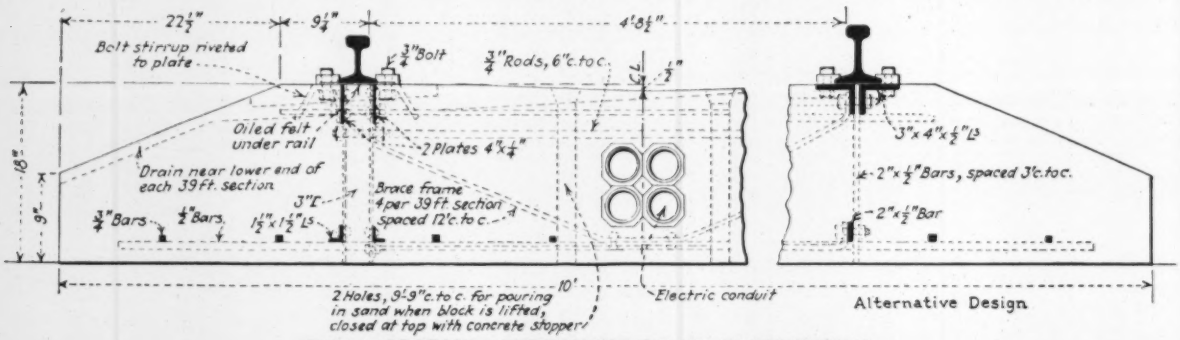


FIG. 1—PROPOSED PERMANENT TRACK CONSTRUCTION

The type of track now in use by railroads was evolved very early in their history. Heavier rails with improved fastenings have been used, the thickness of ballast has been increased, and the ties have been placed closer together, but the general arrangement is still the same. On account of its adaptability to the varying conditions incident to the growth of the railway system, such as unseasoned roadbed and frequent changes of line and grade, no other type of track could have served the purpose as well, either on the score of efficiency or economy. But on most of the railroads in this country a different set of conditions is now encountered. Traffic routes have become fixed. Few changes of line or grade which involve any considerable mileage are contemplated. Embankments have become seasoned and, for the most part, show no further settlement. Wheel loads are approaching the maximum which is permissible, unless steel rails can be made both harder and tougher than at present. The increasing cost of ties is only partially offset by the longer life obtained by treatment. Suitable ballast is increasingly more expensive, and track labor is becoming scarcer and (measured in terms of performance) more costly.

New Types of Track—Careful consideration should now be given by the railroads to the development of a type of track which is more suitable to present conditions on heavy traffic lines. Some pioneer work has been done along this line, both as to suggested design and actual construction. Of the former, J. W. Schaub's contributions as long ago as 1907 are notable. In 1919, A. C. Irwin described a number of such types of track before the American Concrete Institute, while the principal cases of actual construction are described in the "Proceedings" of the American Railway Engineering Association for 1920. [See also *Engineering News-Record*, April 22, 1920, p. 826.—EDITOR.]

Such an installation, even on an experimental scale, is necessarily expensive; and before such expense is incurred it is desirable to profit by past experience and also to consider such suggestions as may be offered. It is hoped that the design of track described below and the estimate of the savings which would result from its use will bring forth constructive criticism which will result in the improvement of the design and also throw light on the economic value of a track of this type.

Permanent Track Structure—By permanent track is meant a track structure in which wear and deterioration are confined as far as possible to the rail. The requirements are exacting, but it is not unlikely that a structure can be developed which would meet even such severe situations as fills that are not fully settled, fills over sink holes or over ground filled with water which may be subsequently removed by drainage, or soils of such texture that freedom from heaving by frost cannot be secured by thorough drainage. However, on old lines these situations comprise only a small fraction of the total.

The structure must be wide enough and strong enough to distribute the load over such an area that the bearing power of the subgrade will not be exceeded. Allowance must be made for impact, for lack of uniformity in the support given by the subgrade, and for the present tendency toward heavier loading. Temperature stresses must be taken into consideration; and protection of the concrete under the rail from disintegration due to repeated shock from the passing loads seems desirable, although trial may prove this feature not to be essential.

The rail attachments should permit easy placing and removal, and the rail must have perfect surface and alignment. However, the design should be such as to permit minor adjustment of elevation by shimming, as occasional slight settlement may be looked for even in seasoned fills, and changes in traffic conditions may necessitate a change in the superelevation of curves. Insulation is another feature, and the design should permit easy connection with the ordinary type of track.

Proposed Track Design—In the design submitted, Figs. 1 and 2, the supporting slab of concrete is 10 ft. wide and 18 in. thick. Assuming the use of 39-ft. rails, the concrete would be cast in sections of that length. The rail rests on the edges of two plates which are embedded in the concrete, and are perforated in order to provide better bond and more bearing on the concrete. These plates serve a four-fold purpose: to distribute the load and impact over a greater area of concrete; to protect the concrete from shock and possible disintegration due to direct contact with the rail; to afford a means of attaching the rail; and to insure a setting for the rail which is absolutely true as to line and surface. In addition, they form a guide for striking off the concrete surface in finishing.

These plates also form the upper chord of a light truss, the lower chord of which serves as a part of the longitudinal reinforcement. The vertical members anchor the rail seat to the concrete, and are extended below the lower chord, so that they may rest upon stakes driven accurately to the elevation of the subgrade. When set in place, these trusses are connected by adjustable tie rods 6 ft. apart, and also by four brace frames for each 39-ft. section. This arrangement gives a rigid framework which can be set accurately to place and will remain undisturbed while the concrete is

being placed. It will also serve to transmit the loads into the mass of concrete.

Longitudinal reinforcement consists of four ¾-in. bars and four ½-in. bars in addition to the two 1½ x 1½ x ¼-in. angles which constitute the lower members of the trusses. The ratio of longitudinal reinforcing metal is about 0.37 per cent. Assuming Cooper's E-70 loading concentrated under the axle, with 50 per cent allowance for impact and uniform bearing on the subgrade, the tensile stress in the steel would be about 9,000 lb. per sq. in. and the compressive stress in concrete about 200 lb. Transverse reinforcement consists of ¾-in. square bars spaced 18 in. c. to c. near the base of the slab, and ½-in. square bars spaced 18 in. c. to c. near the top of the slab. Assuming the 70,000 lb. on a pair of driving wheels to be uniformly distributed over a longitudinal distance of 5 ft. and assuming an impact allowance of 50 per cent and that the upward pressure of the subgrade is uniformly distributed, we obtain a unit tensile stress of 14,000 lb. for the steel and a unit compressive stress of about 300 lb. for the concrete.

These unit stresses are ample to take care of any increase

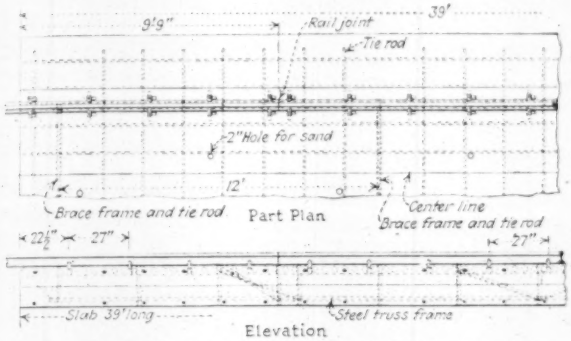


FIG. 2—TRACK SLAB REINFORCEMENT

in future loads, impact and unequal subgrade conditions. On account of the greater length of the section as compared with its width and the consequent opportunity for more variability in the conditions of the subgrade it is thought desirable to use a much lower unit stress for the longitudinal reinforcement than for the transverse.

To facilitate construction, the concrete slab should be poured continuously, and not in alternate sections. A metal separator would be placed at the end of the section being poured, to be removed after the pouring of the adjoining section. It is not planned to leave any well defined joints between the sections, the assumption being that compression due to high temperature would be taken care of by the concrete and that tensile stresses would cause a cleavage at the end of each section, as none of the longitudinal metal is continuous. When these joints develop, they should be filled with tar, as is now done with concrete highways. In construction, the removal of the separator would be delayed until at least a portion of the block ahead of it was poured, thus giving the block behind it a start toward setting and insuring a cleavage practically along the plane of the separator.

Rail Fastenings—The rail is held by clips, attached by bolts to stirrups bolted to the perforated plates and embedded in the concrete. The bolt is placed with the head up and is screwed into a nut which is inserted beneath the stirrup through a recess provided for that purpose. As the recess is only slightly wider than the nut it prevents it from turning. This arrangement tends to lessen the danger of injury to the bolts in case of derailment, and permits their replacement if injury should occur, or the substitution of a longer bolt in case slight shimming is desirable. No angle bars or fish plates are necessary, as the rail seat and rail attachments serve their purpose.

New Rail Section—With such a design, the rail no longer functions as a beam. Wearing surface and a base for bearing and attachment are all that need be provided, so that a suggested 3½-in. 60-lb. rail, with heavy head and base, would be as effective as a 130-lb. rail under present conditions. Rail anchors would not be needed, and the rail could be anchored by one or two bolts near its middle point. If it should prove desirable, which does not appear probable, to give a slight cushioning effect and lessen the impact on the concrete, a thin layer of oiled felt beneath the rail would be effective. Insulation between any two sections of track could be accomplished by substituting insulating fiber for the felt, this insulation extending from the rail joint to the end of he concrete block.

Thorough drainage is essential and, except on sand fills, it should be taken care of by tile drains just beyond the edges of the slab, with frequent outlets to the side of the embankment. In cuts the drains should be placed deeper and under the track ditches, in order to prevent ground water from reaching the track. Conduits for telegraph, telephone, block signals and train control, can be placed in the slab.

Construction and Cost—Such track construction would not be used on single track to any considerable extent, as its cost would not be justified, while it would be necessary to build a temporary track to carry traffic around the section under improvement. Precast slabs, to be inserted under traffic, seem to be entirely feasible, but it is not likely that as uniform a bearing on the subgrade could be had as if the concrete were molded in place. On double track, however, traffic could be diverted to one track, without undue expense or serious interruption of traffic. Under such conditions it is probable that precast section would be more expensive, even taking into account the expense due to traffic interference. It is quite possible, however, that in certain situations the precast method would be more desirable.

An estimate of cost under average conditions is $48,761, reduced to $37,970 by the salvage value of track retired. This is based on the assumption that the railroad company would purchase and deliver all materials and handle diversion of traffic, and that the labor of placing the concrete (including unloading materials) would be done by contract.

Advantages—The advantages that would result from a permanent track may be classified as follows: (1) Reduction in cost of maintenance-of-way; (2) reduction in cost of maintenance of equipment; (3) reduction in train resistance; (4) greater safety, especially at high speeds; (5) more comfort for passengers, due to smoother riding and freedom from dust; (6) advertising value to the early users. An estimate of the annual saving resulting from the first three of the above items on a track having a freight traffic of 30,000 gross tons per day and six daily passenger trains amounts to $3,821, or 10 per cent of the estimated cost.

In the estimate of the reduction in maintenance-of-way expense, $1,600 per mile per year for the present cost of track labor is based on actual costs on the Pere Marquette R.R., which indicate that such cost is approximately:

$$\$275 + \frac{\text{gross tons per year}}{8{,}000}$$

It is assumed that the cost of maintaining equipment would be reduced 20 per cent. There is no definite basis for the assumption of a reduction in train resistance of 1 lb. per ton, but there is a large amount of energy now lost in shocks at rail joints and in depressing the track and pushing the track waves ahead of the locomotive and of each truck.

Conclusions—For roads with heavy traffic, track of the permanent type would result in a reduction of maintenance-of-way expense that would yield a moderate return on the investment cost; it would probably result in large saving in maintenance of equipment and cost of transportation; and would permit the safe operation of trains at considerably higher speeds than are now permissible. With a moderate return assured on the investment from the saving in maintenance-of-way expense alone, it would be well worth while for any road with heavy traffic to install experimental sections of permanent track in order to determine its other economic values, and to develop by trial the details of a practical design.

Railroad Construction in Spain

The Spanish Government loan for the first $45,000,000 for railroad construction and the purchase of material, a part of the total loan of $390,000,000 authorized recently, has been floated successfully, according to reports of the U. S. Department of Commerce. There will be an additional loan of $30,000,000 later in the year. A statement of the various items upon which the entire sum of $75,000,000 is to be spent has been filed with the Department of Commerce in Washington.

Highway Research Develops Definite Objectives

Annual Convention of Highway Research Board Shows Increasing Co-ordination and Definite Planning in Developing Information on Uncertain Questions

COMPLETION of the special investigation into the economic value of steel reinforcement for concrete roads was reported at the annual convention last week of the Highway Research Board. This, with the progress reports of the special studies being made on culverts and on earth roads, was the outstanding accomplishment of a year's work which recorded substantial advance in the tasks of the standing committees but no striking development of information. Special recognition was also demanded by the report on the investigation on urban aspects of highway financing by Jacob Viner of the University of Chicago presented as the major item of the report of the committee on highway finance. There was a constantly good attendance at the sessions and virtually all of the reports received discussion. In all respects the proceedings kept close to problems of research and to discussion based on actual findings of fact.

A characteristic of the committee work which stood out as each chairman presented his report was that it represented full membership action and effort. Some phase of each committee's problem had been made the task of one member and his sub-report, although presented individually, had met the scrutiny and was the expression of the full committee. Equally impressive, as the reading of the reports proceeded, was the evidence of co-operation in the investigations by state highway departments, institutions and industrial organizations. In many instances this co-operation had taken the character of special surveys, involving considerable time and cost, which were put into the hands of the committees for such uses as they could serve. It was impressively evident that a position has been attained which warrants an advance in committee work beyond recital of elementary activities.

Standing Committee Reports—As the work of the standing committees is a continuing study of their assigned subjects, the reports were all reports of progress announcing the completion of some phases of the studies, the continuation of others and the beginning of still others. All contain each year addenda of facts in much detail and only outstanding facts can be presented. In the order presented the first report was that on the economic theory of highway improvement by Prof. T. R. Agg, Iowa State College.

Five principal phases of the subject were reported on: (1) Relation of tire tread wear to type and condition of road surface, (2) intensity of downward kick of rear wheels of vehicles starting from rest; (3) wind resistance of motor vehicles, (4) relative wear and tear on highways produced by heavy and light motor trucks, and (5) tractive resistance. In order the essential findings were as follows:

Considering the tire wear on concrete as unity the wear indices for other surfaces are: monolithic brick 1.01; bituminous filled brick, 1.00; Iowa gravel 2.20; chert gravel, 7.30, and bituminous macadam without seal coat, 10.60. The wear on macadam may be 17 times as great as on concrete and on poor macadam may be 56 times as great. Theoretical analysis and experiment with twelve vehicles tend to show that the downward kick ranges from 100 lb. to as much as ten times that intensity. As determined by wind tunnel measurements the intensity of wind resistance appears to follow closely the law: $R_w = 0.0025\,AV^2$, where R_w is the total in pounds, A is the projected cross-section of the vehicle in square feet, and V is the velocity in miles per hour of the air with respect to the vehicle. In respect to tractive resistance it is found that the sum of rolling and air resistance is correctly expressed as: $R_t = R_r + R_w$, in which R_t is the sum, R_r is the rolling resistance for the particular type of tire and road and R_w is the air resistance. A large number of determinations of R_r give 20 to 30 lb. for good surfaces and as much as 100 lb. per ton on inferior surfaces. The figures on truck wear of roads are so many and diverse that brief presentation is impracticable. The committee reported also that results of the studies on rolling resistance and gasoline consumption are not at a stage where they can be announced.

A summary of the report on structural design of roads by A. T. Goldbeck is:

The most unfavorable subgrade conditions are due to excess moisture in soils that are affected thereby. Such excess moisture results from (a) poor surface drainage, and (b) poor internal drainage. Under the most favorable climatic conditions few failures are due to the subgrade. Favorable climates involve moderate temperatures with comparatively low precipitation, and particularly low precipitation during the winter months. Unfavorable climates have long continued periods of cold weather; high precipitation during freezing weather; or frequent alternations of freezing and thawing combined with deep freezing.

Tests indicate that concrete, when reinforced with small amounts of steel, may be extended more without visible cracking than when unreinforced. The extensibility of dry concrete beams was found to be less than that of wet specimens. Deformation measurements in existing concrete roads furnish an excellent index of the load-carrying ability of the slab. The recent measurements corroborate the thickened edge design. Tests in Cook County, Illinois, indicate that a 9-7-9 section is suitable for an 8,750-lb. maximum wheel load. It is indicated that, for all practical purposes, the stress produced in concrete pavements is directly proportional to the wheel load. Within practical minimum limits of axle spacing, the individual axle loads of a six-wheel truck may be as heavy as in the case of a four-wheel truck. Stresses in concrete pavements have been determined by the mathematical theory of elasticity closely approximating those determined by test measurement. Tables of stresses have been prepared from which it is possible to proportion the slab under given conditions. The analysis shows that the "stiffness factor" of the subgrade does not greatly affect the pavement stresses. Attention is called to a promising experiment in which an attempt is made to control the transverse cracking in concrete pavements. This is done by creating transverse planes of weakness in the pavement during construction.

The latter experiment is being carried out in North Carolina. In the standard reinforced road slab at every 40 ft., the reinforcement is omitted in a zone of 1 ft. wide across the slab. In the middle of this zone a notch 2 in. deep, $\frac{1}{4}$ in. wide on the bottom and $\frac{1}{2}$ in. wide at the top is molded across the slab to form the transverse plane.

Materials Research—Road materials studies as reported by H. S. Mattimore, Pennsylvania State Highway Department, were directed particularly to high alumina cements, zone paints and accelerators in portland cement. On alumina cements the report was largely a summary of existing published information with the committee's comment that it appeared to be shown that this cement was resistant to acid and alkali waters. More important was the fact that the strength of this class of cement at 24 hours' age is equivalent to that of portland cement at 28 days. It was noted in respect to zone paints that the important qualities are consistency, spreading rate, hiding power, drying time, light resistance, visibility and durability. Apparatus for making these tests was suggested and some account of this will be given in separate articles. Calcium chloride as an accelerator had been especially considered and in a general way the indications were that this material and compounds with a calcium base may perform the useful function of accelerating the hardening of concrete. The rate of acceleration for the compounds commonly used is in a direct relation to the calcium chloride content. The principal advantage of all accelerators is to secure early high strength. This results in the earlier possible use of the structure and in protection against adverse curing conditions. It was notable that a particularly conservative attitude toward both high alumina cements and cement accelerators was taken by the report.

Traffic Research—Objection to the three-lane roadway was voiced in the report by G. E. Hamlin, Connecticut State Highway Commission, of the committee on highway traffic analysis. The report stated: "It is evident that a three-lane roadway will permit vehicles to pass each other with a greater frequency than on a two-lane road. The three-lane roadway, however, provides conditions under which accidents may frequently occur. The committee recommends the use of a four-lane roadway when the capacity of the two-lane two-way roadway is exceeded."

Transportation surveys indicate a close relationship between population per square mile, the trend of population, growth and industrial development, and the amount of traffic using the highways. The prediction of expected future traffic based on the projection of the trend of motor vehicle registration is a reasonably accurate measure of future highway traffic.

Maintenance—For the committee on maintenance the chairman, W. H. Root, Iowa State Highway Commission, stated that in the matter of dust prevention it was found that light asphaltic oils are used to a limited extent and are effective for six weeks to one season. Two or three applications of calcium chloride are effective for one season, and a cumulative effect is noted after two or three years of treatment. Bituminous mats are maintained on gravel by using both hot and cold applications. Two treatments in three years or three treatments in four years are necessary. An analysis of crack filler practice shows great lack of uniformity and the need of investigation. Snow removal is being extended. During the winter 1924-5, some 48,000 miles of road were included in the snow removal program of 35 states. Nine states include their entire road system in the snow removal program. The cost of snow removal is greatly diminished by proper attention to drift prevention. Four requirements of organization are: (1) an efficient organization, (2) a definite program, (3) suitable and ready equipment, and (4) a plan of action that will start with the storm and continue until the roads are open. A standardization of maintenance accounting was urged. Need of a study of maintenance costs as affected by pavement age was pointed out and special reference was made to the studies at Columbus, Ohio, the first study of which was given in *Engineering News-Record*, July 23, 1925, p. 140, and another study of which will be published shortly.

Special Investigations—Leading in the reports of special investigation was that on the economics of steel reinforcement for concrete pavements by C. A. Hogentogler, special investigator for the Highway Research Board. In this study many hundreds of miles of concrete roads were surveyed for original structure and construction and for present surface conditions. The report presented included some scores of crack maps, charts and tabulations and literally hundreds of details. These lead to certain general conclusions which will be published in a succeeding issue.

The investigation of earth roads by S. S. Steinberg of the Highway Research Board has been confined this year to a collation of existing information—previous and current investigations, a bibliography, list of patents, and earth road statistics. The study will go ahead with an extensive field program to discover in what way using the natural materials, manipulation or treatment of the road surface will add to its service qualities. A similar report of progress was made by Prof. R. W. Crum who is directing the studies on culverts. It is proposed in this study to examine many thousands of culverts and enter the findings on standard blanks devised after a survey of some 600 culverts to determine essential features necessary to be investigated.

Civil Aviation in the United States

Fundamental difficulties which are retarding the development of civil aviation in the United States are, according to the findings of the Committee on Civil Aviation of the U. S. Department of Commerce and the American Engineering Council, the lack of a definite legal status and governmental control; the lack of an established government program to encourage the civil and industrial uses of aircraft; the lack of commercial aircraft and equipment best adapted to profitable commercial operations; and the consequent lack of public and business confidence and support. To remove these fundamental handicaps this committee recommends that Congress enact a civil aeronautics law establishing a bureau of aeronautics in the Department of Commerce to regulate air navigation and to license pilots and inspect aircraft and otherwise supervise and encourage civil aviation; that the government refrain from non-military flying activities which can be properly performed by private operation; that the government extend its use for the handling of mails, forest surveys, etc., these operations to be carried on under contract wherever possible; that lighted airways be established, emergency landing fields be provided, the limited use of governmental fields be extended to private companies, and that the United States government ratify the International Air Navigation Convention.

Flood Protection Works Progress at Peru, Ind.

Economic Conditions and Safety—Works Include Concrete River Walls, Levees, Ditch, and Clearing River Channel

PROMPTED by the property damage and loss sustained in the great Ohio Valley floods of 1913 and spurred by successive floods in 1914, 1916 and 1919, all causing serious interruption to business and industrial enterprises, the city of Peru, Ind., has adopted the policy of providing adequate flood protection and the works are now under contract, after several years of investigation, planning and legal procedure.

Topographic and Hydraulic Conditions—This city, with a population of about 15,000, is situated mainly on low ground along both sides of the Wabash River, from which the ground rises steeply on the north end and less steeply on the south. Above Peru the river has a drainage area of about 2,866 square miles, including its tributary the Mississinawa, entering just above the city. The normal low-water and high-water flows are about 900 and 50,000 sec.-ft., respectively, with elevations of 619.5 and 640 ft. above sea level at Broadway. While the elevation of the business portion of the city is at about El. 639 to 645, much of the residence portion is below El. 639.

Hill waters aggravate the river situation. Runoff from the hills beyond North Peru, in the drainage area between the Lake Erie & Western R.R. and Rettig Creek, soon fills all available storage areas, overloads the 18-in. pipe culvert carrying Prairie Ditch through the railroad embankments, overflows the Still-House Ditch and then pours over the Belt Line R.R., flooding Oakdale, North Peru and the eastern part of Peru. The general situation, with relief works now under construction, is shown in Fig. 1.

Numerous Floods—At various times the city has suffered damage and interruption to business by flood waters, but the great flood of 1913 caused the loss of eleven lives and a property loss of over $2,000,000, while factories and industrial plants were shut down and thousands of employees thrown out of work. This flood reached El. 647.2 and an estimated maximum flow of 86,000 sec.-ft. Other floods which were serious, but of which no height records are available, occurred in January, 1914, and January, 1916; the latter not only did a great amount of damage but interrupted both city and interurban railway service. Still more serious was the flood of March 17, 1919, which reached El. 639.40 and resulted in all railroad communication being cut off by washouts or deep water. All schools were closed, the electric light plant was shut down, the water-works was flooded so that the city had to use river water, business and industry were interrupted and the city appealed to the mayor of Rochester, Ind., to send boats and men for rescue work in the flooded district.

River Channel and Bridges—Through the city the river is fairly straight, though there are sharp bends above and below. But the channel is reduced in cross-section by numerous fills and dumps and bridge abutments, by bridge piers for relatively short spans and by bridge superstructures below the high-water level. In addition the flood capacity of the channel is reduced by islands, by bars of gravel and sand, and by obstructions to flow along the banks. Numerous trees stand on the sloping banks as far down as the low-water line and the effect of these obstructions can be noted in the channel velocities for considerable distances out into the stream.

Six bridges cross the river. At the east end, and at a narrow point just above a bend in the channel, is the Chesapeake & Ohio R.R. bridge with five steel girder spans totaling 374 ft. Then come the Wallace Ave. bridge, with seven concrete arch spans having a total length of 648 ft.; the Broadway bridge, with three through truss spans, total 344½ ft., and just below it (but with piers of different spacing) the Union Traction Co. bridge with four steel spans aggregating 379 ft. At the west end of the city are the Lake Erie & Western R.R. bridge, with three steel truss spans and three deck girder spans, totaling 587 ft.,

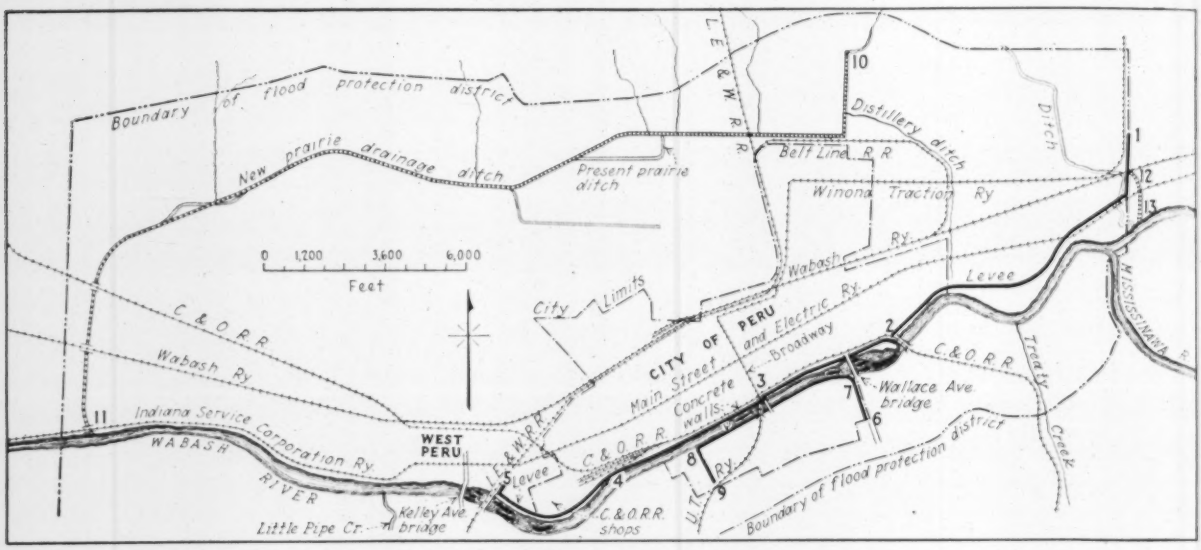


FIG. 1—FLOOD PROTECTION WORKS FOR PERU, IND.

Sections 1 to 2, earth levee; 2 to 3, C. & O. R.R. embankment, raised and reinforced; 3 to 4, plain concrete river wall; 4 to 5, and 6 to 7, earth levees; 7 to 8, reinforced-concrete river wall; 8 to 9, earth levee; 10 to 11, improved Prairie Ditch; 12 to 13, diversion of Rettig Creek. Bars and obstructions to be removed from river channel are shown in black.

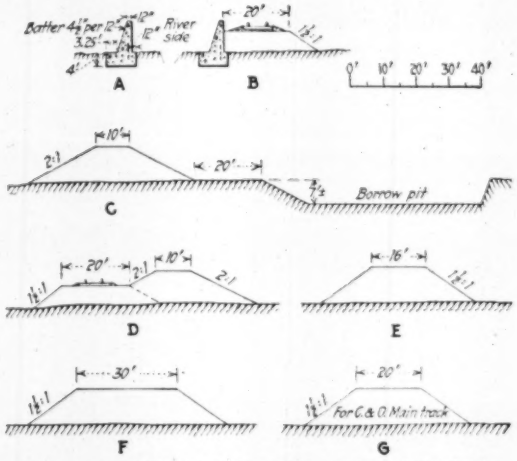


FIG. 2—GRAVITY WALL AND LEVEE SECTIONS

and the Kelley Ave. bridge with three steel truss spans totaling 420 ft. In connection with the flood protection work the Chesapeake & Ohio bridge will be raised 4 ft.

Flood Protection Works—Five main works will comprise the flood protection system, as indicated in Fig. 1: (1) A long river front protection on the north bank, partly levee, partly enlarged railway embankment and partly concrete wall; (2) a combination of levees and concrete wall along the south bank; (3) a drainage and intercepting ditch around the north and west sides of the city; (4) the removal of islands and obstructions in the river channel, and (5) alterations to one of the bridges.

On the north side of the river, Rettig Creek will be diverted and a levee built starting from high ground at the east and extending to the embankment of the Chesapeake & Ohio R.R., which bank will be reinforced. Beyond this will be constructed about a mile of concrete retaining wall, beyond which another levee will continue to high ground on the west. On the south side there will be about a mile of concrete wall along the river front, with flanking levees at each end.

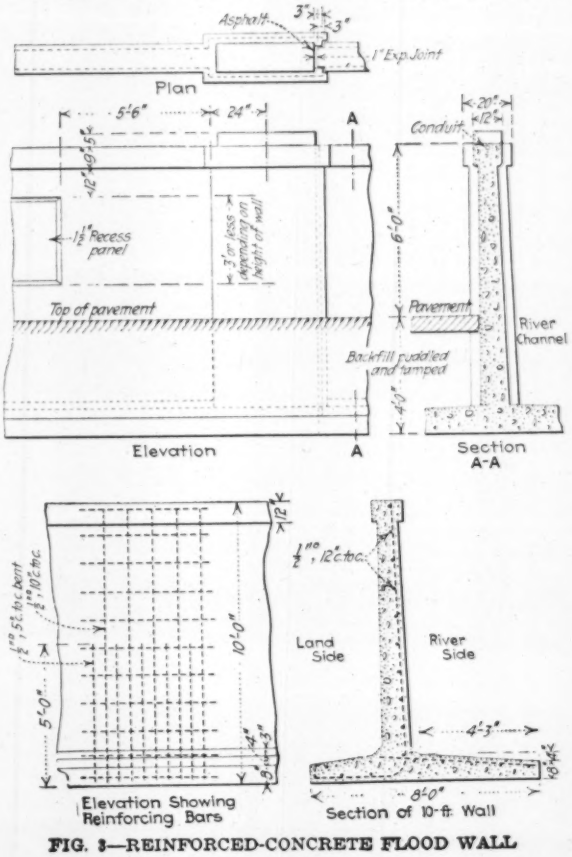


FIG. 3—REINFORCED-CONCRETE FLOOD WALL

River Walls and Levees—The flood wall on the north side of the river will be of plain concrete, of gravity section, about 4 ft. high, with its top 2 ft. above the high-water level of 1919. Behind this wall the ground will be level with the top of the footing. The river face will be vertical as at *A*, Fig. 2, which is the section used through the Chesapeake & Ohio R.R. yards, away from the tracks. Where the wall forms the facing of the railroad embankment, the battered face will be on the river side, as shown at *B*. The flood wall on the south side will be of reinforced concrete, shown in Fig. 3, with a height of 6 to 10 ft. or an average of 8 ft., with the base 4 ft. below the ground surface on the land side, where the backfill will be puddled and tamped and then paved. The wall will be built in 50-ft. lengths, having asphalt-filled expansion joints 1 in. wide formed in pilasters, as shown. Recessed panels and a top coping will relieve the long flat wall surface. A 1:2:4 mix will be used, with stone or gravel of not more than 1-in. size, and 10 lb. of hydrated lime will be added for each sack of cement.

Levees, to be made mainly by dragline excavation from borrow pits, will have a top width of 10 ft. and slopes of 1 on 2, with a berm of 20 ft. between toe of fill and edge of borrow pit, as in sections *C* and *D*, Fig. 2. The crest will be 4 ft. above the high-water level of 1919. Where the levee is to be built by filling from railroad cars, the top width will be 16 ft. and the slopes 1 on 1½, except that the top width will be 20 ft. where the levee is occupied by the railroad and 30 ft. where it forms a highway, as in sections *E*, *F*, and *G*. There will be no revetting of the slopes.

Engineers and Contractors—The Peru flood control district, taking in an area of about 9,800 acres, was organized in 1921, with a board of commissioners, and plans were submitted to the state authorities for approval in 1922. Contracts were let as follows in April, 1925: Earthwork, including levees, ditches and clearing the river channel, Walb Construction Co., LaGrange, Ind., and Matthews Bros., Erie, Ill.; reinforced-concrete river wall, Minnex & Clark, Flora, Ind. The contract for the longer gravity wall was to follow these. T. N. Jacob, consulting engineer, St. Louis, Mo., was chief engineer for the Peru Flood Control District, with Lewis E. Roberts, Peru, Ind., as assistant engineer in resident charge. Since the death of Mr. Jacob, in May, Mr. Roberts has been appointed acting chief engineer.

The entire cost was estimated at $350,000, but contracts were, in part, awarded below estimate.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Welded Pipe Used to Carry Gas Line Over Subway Operations

SUBWAY construction in large cities involves much more than merely digging a trench and laying track in it. One of these things is the disposal of existing underground structures while the subway building operations are under way. In a section of Philadelphia the gas system is so laid out that a pipe line crosses the subway route at every cross street for its entire length. This pipe exists in sizes up to 18 in. in diameter. Each crossing requires a clear span of 80 ft. The contractor has adopted a method of using welded pipe supported on each side of the street by a structural steel tower which also serves as an anchorage for a suspension line that is attached to each length of pipe in the span.

A 90-deg. bend is fitted into the cast-iron gas line at an appropriate point on each side of the street. This

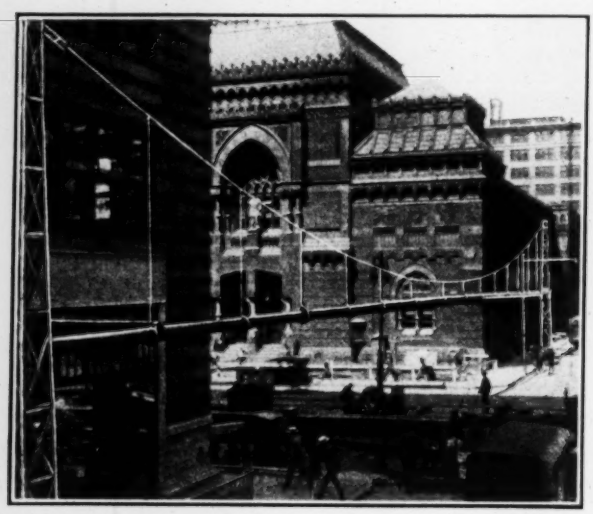


FIG. 1—GAS PIPE SUSPENDED OVER STREET DURING SUBWAY CONSTRUCTION

is so placed that a bell end set in a concrete collar is at the top; thus a length of steel pipe can be set down into it vertically and leaded. This steel pipe is supported in the structural framework of the tower. At the top, a three-piece 90-deg. welded bend turns the pipe again into the horizontal position, 14 ft. above the sidewalk.

Pipe lengths for the suspended section are beveled with the blowpipe, and at one end four short straps, about 1½ in. wide, are welded to the inside of the pipe; these are to aid in aligning. Two hooks are welded at diametrically opposite points on the outside of the pipe, at both ends of each length. These are used to draw the lengths together and hold them rigidly while they are being welded. Vertical cables are dropped from the suspension line between the towers and attached to collars on each pipe length. An arm also extends from each side of the collar, its ends fastening to two cables running parallel to the pipe line. This arm structure trusses the line against lateral movement caused by heavy wind or accidental collision. The collars

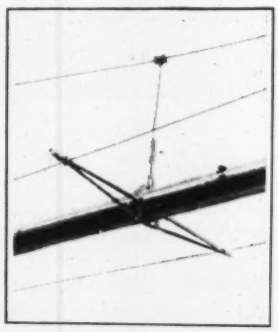


FIG. 2 (LEFT)—TRUSS ARM TO RESIST LATERAL MOVEMENT

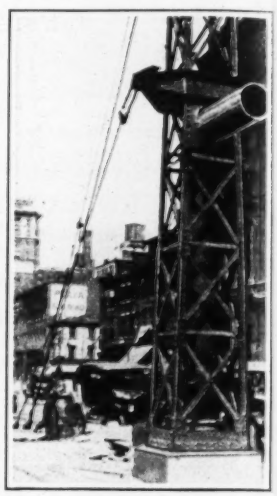


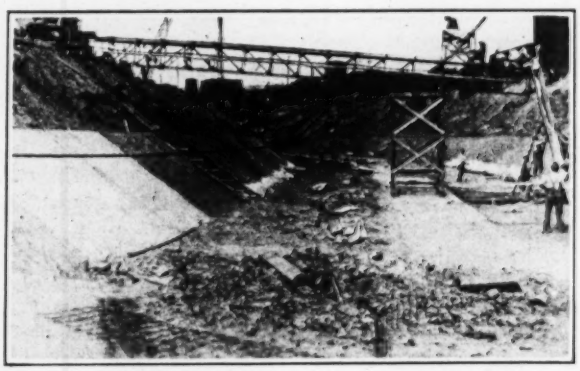
FIG. 3 (RIGHT)—ANCHOR TOWER

are welded solid to the pipe on the top half, and tack-welded underneath.

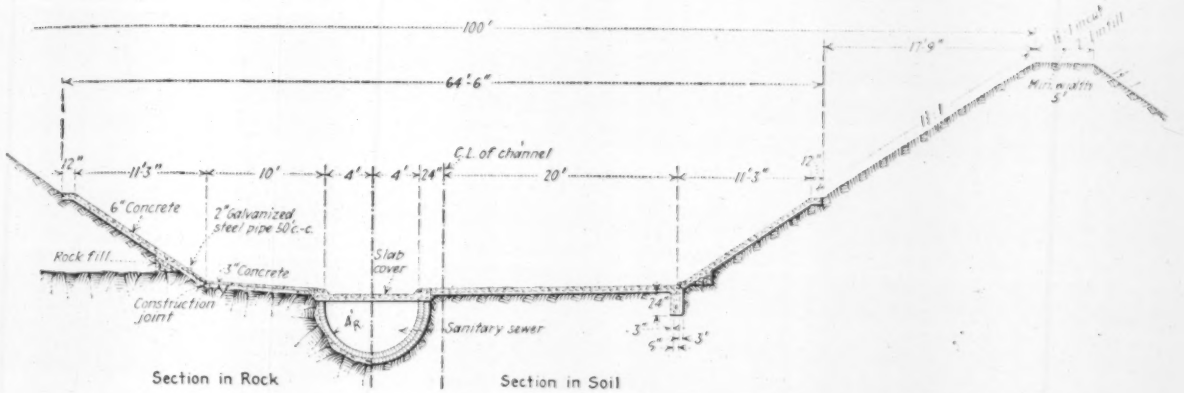
Each length of pipe was hoisted into position and the ends drawn together by means of the welded hooks. The pipe was welded by an operator working from a suspended platform. When the welding was completed, the hooks were cut off. The material for this article was obtained from the Linde Air Products Co.'s publication, *Oxy-Acetylene Tips*.

Belt Conveyor Handles Concrete to Slopes of Drainage Channel

IN THE construction of Section *A* of the River des Peres drainage works in St. Louis, a belt conveyor designed by the contractor and the city engineers was used with notable success to place the concrete for the lining. Section *A* is part of a $11,000,000 bond issue program to convert the River des Peres into a sewer. The course of the lower 9 miles of the stream leads



BELT CONVEYOR PERMITS CHUTING CONCRETE DIRECTLY TO PLACE IN LINING



RIVER DES PERES COMBINED SANITARY SEWER AND STORM WATER CHANNEL

through industrial and undeveloped neighborhoods for which a separate sanitary sewer with an overflow storm water channel was designed. The drawing shows a typical section of the work along a section which is 7 miles above the outlet into the Mississippi River.

For construction an industrial railway with a central proportioning plant was the only logical haulage method but several methods of placing were possible. The limits of the right-of-way made one side of the channel inaccessible for working room, hence all of the work had to be handled from one side of the channel. Nor was hauling on the subgrade of the channel considered for the reason that rains would flood the channel with

BANK END OF CONVEYOR RECEIVED CONCRETE DIRECT FROM 21-E MIXER

5 to 15 ft. of water with only three hours' notice. Chutes from towers, cableways, chutes with hand shoveling up the slopes were considered, but a traveling belt conveyor was chosen as the most economical.

The conveyor is essentially a 16-in. five-ply belt driven by a 5-hp. motor off of a 10-in. pulley on one end. The belt travels at the rate of 200 ft. per minute and carries concrete at the rate of 100 tons per hour. The machine is 70 ft. long, center to center of pulleys, and weighs approximately 3 tons. The bank end of the conveyor is mounted on a swivel on the underframe of a 24-in.-gage car which runs on tracks. The channel end bears on a 6-in. roller on the top of a tower framed of 4x4-in. timbers. This tower is pushed forward by the men spreading the concrete. About twelve men are required to move the whole conveyor.

The tripper or discharging device, which is on a carriage and can be moved to any part of the truss, allows the conveyor man to discharge concrete into the chute on the side or let it run over the idler and back onto the belt, where it goes to another chute at the end of the truss.

In lining 1 mile of the channel, no trouble has been experienced in the operation or maintenanec of the conveyor. It will discharge the contents of a 21-E mixer in 50 seconds.

This work is being carried out for the city of St. Louis by E. E. Ashlock, resident engineer, and Thomas Knobel, principal engineer of construction, under W. W. Horner, chief engineer of sewers and paving of the city of St. Louis. The contractor is the J. J. Dunnegan Construction Co. of Shenandoah, Iowa, for whom J. J. Gilmore is superintendent. The conveyor was constructed by the General Conveyor Manufacturing Co. of St. Louis, and is the result of the ingenuity of Messrs. Knobel, Ashlock and Gilmore in conference with the engineers of the conveyor company.

Ready Means of Estimating Quantities of Concrete Materials

By E. Earl Glass
Manager, Pacific Coast Sand & Gravel Association, Los Angeles, Calif.

SINCE the adoption of the ton unit for measuring sand, rock and gravel in southern California there has been an urgent need for a ready means of estimating the quantities of materials that go into any given mix of concrete. About ten years ago the writer devised a variation of Fuller's concrete materials formula which gave results closely approximating those furnished by Taylor & Thompson's tables. This formed the basis for an attempt to answer the problem herein presented.

It is well known that there is considerable range in the assumption that a sack of cement is equal to 1 cu.ft. The degree of compacting to which this material is susceptible makes it reasonable to assume here that a cubic foot of cement weighs 100 lb. The same weight is a very good average for the weight of ordinary concrete aggregate, both fine and coarse. With this assumption, we have the three ingredients of plain concrete reduced to an equal weight basis and any mix may therefore be worked out by simple proportion.

Since the average weight of plain concrete is 145 lb., the material required for any job may be determined

closely by finding the number of cubic feet of each kind or mixture of concrete and using this straight-line formula. Then merely by assuming that all materials are of approximately the same weight, the pounds of cement in each cubic foot of concrete will be the weight of 1 cu.ft. of concrete or 145 lb. divided by the sum of the parts in the mix. This weight times the parts of sand or stone will give the weight of sand or stone per cubic foot of concrete. It is believed that this formula is sufficiently accurate to take its place beside the older formulas and tables. One advantage of this rule is that it will give the approximate weight of materials required for the odd proportions encountered where the mix is fixed by screening tests and the fineness modulus.

This rule is offered contractors with the recommendation that it is as accurate as the estimating methods they have used heretofore and it should make the ton unit more popular with some who have been puzzling over conversion factors and other means of applying the new weight units to the old box measures.

COMPARISON OF STRAIGHT LINE FORMULA WITH TAYLOR & THOMPSON TABLES FOR MATERIALS REQUIRED FOR VARIOUS MIXTURES OF CONCRETE

Concrete Mix	Quantities per Cu.Yd. of Concrete: Cement, Bbl.	Sand, Cu.Yd.	Stone, Cu.Yd.	Sum of Parts	Quantities per Cu.Ft. of Concrete—Cement, Lb.: T & T	S-L-F	Sand, Lb.: T & T	S-L-F	Stone, Lb.: T & T	S-L-F
1:1 : 2	2.52	0.37	0.75	4	35.2	36.2	37	36	75	72
1:1 : 3	2.03	0.30	0.90	5	28.5	29.0	30	29	90	87
1:1½ : 3	1.83	0.41	0.81	5½	25.5	26.3	41	40	81	79
1:2 : 3	1.67	0.50	0.74	6	23.3	24.2	50	49	74	73
1:2 : 3½	1.54	0.46	0.80	6½	21.6	22.3	46	45	80	78
1:2 : 4	1.44	0.43	0.85	7	20.2	20.7	43	42	85	83
1:2 : 4½	1.34	0.40	0.89	7½	18.8	19.3	40	39	89	87
1:2 : 5	1.26	0.37	0.93	8	17.6	18.1	37	36	93	91
1:3 : 5	1.11	0.49	0.82	9	15.5	16.1	49	48	82	81
1:4 : 6	0.91	0.54	0.81	11	12.8	13.2	54	53	81	80
1:4 :10	0.67	0.40	0.99	15	9.4	9.6	40	39	99	97

In the table herewith the first columns show the quantities of materials for 1 cu.yd. of rammed concrete as given in Taylor & Thompson's tables, based on a barrel of 4 cu.ft. and 40 per cent voids in broken stone or gravel. The last three columns show the reasonable degree of agreement between the two estimating methods. It will be seen that the differences between the two fall well within the range of accuracy to be expected of such tables or formulas.

Large Pipe in Trench Moved Bodily by Motor Trucks

IN 1916 the city of Sacramento laid a 36-in. pipe across a piece of railroad property under an agreement whereby the 720-ft. length of the line on private property would be moved to a parallel position some 9½ ft. distant and just off the railroad property if the railroad should ever require it. The railroad recently served notice on the city that this move must be made.

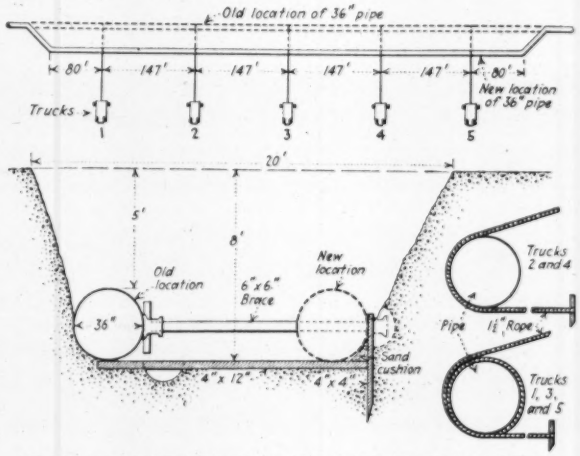
Since the move was for so short a distance it was decided to excavate a trench to uncover the pipe and also wide enough to allow the pipe to be rolled to its new location. The pipe could be moved, it was believed, by the direct pull of five motor trucks.

Accordingly, a power shovel was used to excavate a trench, as shown in the accompanying illustration, 20 ft. wide and 8 ft. deep. In the bottom of this trench 4x12-in. skids were laid on 30-ft. centers and braced against stakes so placed that there would be no danger of the skids slipping lengthwise during the rolling.

From Job and Office

Hints that Cut Cost and Time

One and one-half inch ropes were then passed around the pipe at five points, as indicated in the sketch, and each rope was made fast to a truck on the ground above, headed at right angles to the trench. The cables from trucks 1, 3 and 5 were passed entirely around the pipe; in the case of the other two lines, the pipe



PLAN AND SECTION SHOWING PIPE MOVING SCHEME

simply lay in the bight of the cable. The exact distance that each truck was to move was marked off on the ground and at a given signal all trucks started simultaneously. The actual time of moving was only 4 seconds and everything occurred as planned.

Before the move, depressions had been excavated near the original position of the pipe so that flanges attached to the line for service connections would not strike the trench bottom as the pipe rolled. After the excavation and until the trucks were ready for the move, 6x6-in. braces were put between the pipe and the opposite side. These were to prevent any sand slips that might occur from pushing the pipe out of line. A sand cushion was provided against which the pipe would strike on reaching the new position.

The pipe in its first position was cut by oxyacetylene torch just before the move; immediately after the move 45-deg. ells were welded into place to reconnect it with the continuation of the old line. When the connections had been made and pressure put back on the line not a single leak was found.

JOB COST TABLE

Excavation (3,400 cu.yd.)	$585.00	
Backfill	400.00	
Total for earthwork		$985.00
Cutting pipe		4.00
Making four 45-deg. ells	330.00	
Welding	82.50	
Total for new pipe		412.50
Labor, trimming, moving, placing fills, etc.		686.51
Total cost		$2,088.01
Cost per foot		2.784

The foregoing information was taken from a paper by J. I. Prugh, superintendent of water, Sacremento, Calif., presented at the recent annual convention of the California section, American Water Works Association.

From Job and Office

For Contractor and Engineer

Hand Signals for Locomotive Cranes

FOR safe control in the handling of locomotive cranes, a set of hand signals was submitted by the Committee on Reduction of Accidents to Employees, at the recent convention of the American Railway Bridge and Building Association. They are as follows:

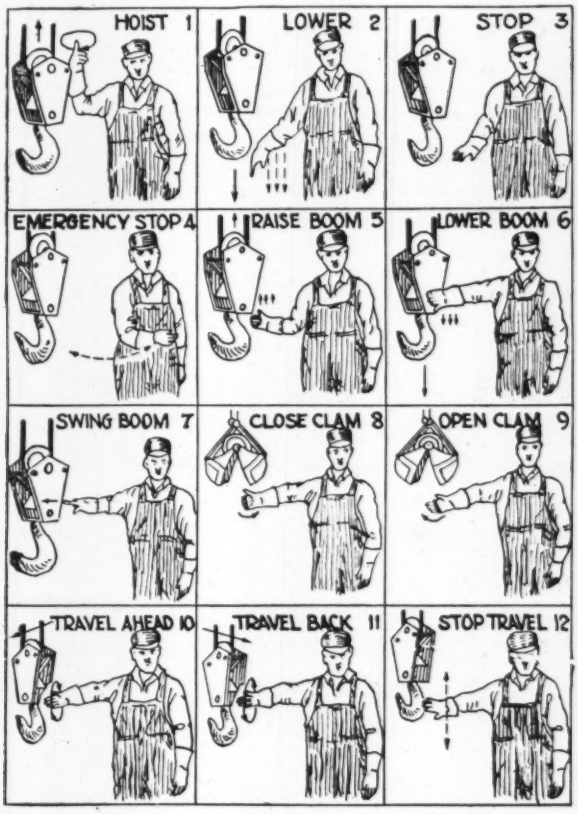
1. HOIST—Forearm vertical. Make small horizontal circle with the hand.

2. LOWER—Arm extended, hand below hip, wave forearm downward.

3. STOP—Arm extended, hand level with hip. Hold position rigidly.

4. EMERGENCY STOP—Arm extended, hand level with hip. Wave hand quickly to right and left.

5. RAISE BOOM—Arm extended, fingers closed, thumb up. Jerk arm upward.



SIGNALS FOR LOCOMOTIVE CRANES

6. LOWER BOOM—Arm extended, fingers closed, thumb down. Jerk arm downward.

7. SWING BOOM—Arm extended, forefinger indicating direction of swing.

8. CLOSE CLAMSHELL—Arm extended, fingers half closed. Close fingers to close clamshell.

9. OPEN CLAMSHELL—Arm extended, fingers half closed. Open fingers to open clamshell.

10. TRAVEL AHEAD AWAY FROM SIGNALMAN—Arm extended, fingers open. Make small vertical circle clockwise with the hand.

11. TRAVEL BACK TOWARD SIGNALMAN—Arm extended, fingers open. Make small vertical circle counter-clockwise with the hand.

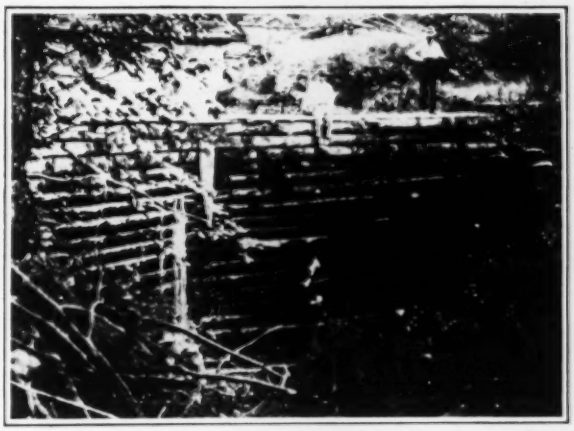
12. STOP TRAVEL—Arm extended fingers open. Move arm quickly up and down.

In handling materials by cranes, the men should be instructed concerning the meaning of the signals and be warned to be watchful. The crane operator should use extreme care not to catch men between the load and the side of the car and should caution the men against standing or passing under the line of travel of the load. When handling maximum loads, the operator should test the hoist brakes after the load has been lifted a few inches; if the brakes do not hold the load should be lowered at once and the brakes adjusted or repaired."

Dam Built on Miter Lock Gate Principle

BY E. W. LANE
Detroit, Mich.

A SMALL mill dam near Ithaca, N. Y., shown in the photograph, which is built on the miter lock gate principle, illustrates a type of dam which is very unusual, possibly unique, yet under certain conditions



SIMPLE DAM OF MITERED TIMBERS

would prove to be very economical. It is built in a small rock gorge about 35 ft. wide at the top and sustains a head of about 12 ft. It consists of rough hewn logs abutting on the rock sides of the gorge and mitered together in the center like a lock gate. It is probably faced on the pond side with planks, although an earth fill could be used. At the bottom, although the timbers resist a greater water pressure, on account of the narrowing of the gorge, the span is reduced and, therefore, little if any increase in thickness is required.

For a low dam in a narrow rock gorge, where timber is plentiful, or for temporary use, it is doubtful if a dam could be built as cheaply by any other method.

Job and Office Notes

"Many Ocean-Front Industrial Plants and others wherein the sprinkler heads of the fire protective system become corroded from the salt air or from noxious vapors, find themselves at a loss to know what to do to prevent the corrosion of the heads and of the piping of the system," writes Claud C. Brown, Los Angeles, Calif.—"The following formula," Mr. Brown explains, "if properly made up, will protect the sprinkler heads from corroding and at the same time will not impair their functioning in case of fire. Take 1 lb. of boiled linseed oil, 1¼ lb. of rosin, 3½ lb. of paraffine, and a little lamp black and melt them all together. When the mixture has attained a temperature of about 180 deg. F. dip the heads quickly into the liquid. The dipping has to be done quickly or the solder of the heads will be melted. If, after the heads are dry, the coating chips off, this chipping is an indication that too much rosin has been used. However, the above proportions of the ingredients have been used and have given excellent results."

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Electrically Welded Water Pipe; Tacoma's Experience

Sir—I have read with considerable interest your editorial on electrically welded pipe (Nov. 12, p. 785), referring to the contract awarded for 85 miles of electrically welded pipe, 60 to 65 in. in diameter, on the Mokelumne project in California. Unit stresses in this pipe are to range up to 14,000 lb. per sq.in. for heads approaching nearly 400 ft. (your issue of Oct. 8, p. 608). The water department of the city of Tacoma has had some experience with electrically welded pipe during the last three years which bears out some of the contentions in your editorial and might be of interest to some of your readers.

About three years ago the writer was preparing estimates covering the rebuilding of Tacoma's 43 miles of Green River gravity supply line and at that time was seriously considering the use of electrically welded pipe for this purpose, because of the saving that might be effected. However, on account of the meager information available on this kind of pipe, especially for diameters from 44 to 66 in. and for plate thicknesses ⅜ in. and upward, it was decided to try this pipe first on smaller and less important lines in the city where the head was less than 100 ft. During 1922 the department therefore contracted with a San Francisco company for 1,143 ft. of 30-in. electrically welded pipe which was to be made up of ¼-in. flanged steel in lengths of approximately 30 ft. with Dresser couplings for field joints. This pipe was inspected in the shop by a capable testing engineer before shipping. The specifications called for one joint-efficiency test for every 100 ft. of pipe indicating not less than 80 per cent of the strength of the plate and for a drop test of 2 ft. on to wooden blocking. The pipe was shipped to Tacoma by boat and re-inspected on the dock upon arrival. The boat encountered rough weather, and when the pipe was re-inspected upon delivery it was found that the welded joints had developed a large number of hair cracks. The welding crews repaired the defective joints under direction of the water department, going over every section of pipe three times. The pipe was then loaded on trucks and hauled about a couple of miles over paved streets to the point where it was laid. In spite of all the care taken in the re-inspection, another crack developed a day or so after the pipe had been placed in service. Repairs were made by plating the crack, using a sheet-lead gasket, because the pipe could not be taken out of service at that time.

During 1924 the water department contracted with a Portland pipe company for 2,160 ft. of 32-in. electrically welded pipe made up similar to the aforementioned pipe. In order to get first-hand information on shop practice in making up electrically welded pipe, the writer inspected this pipe personally. Each section after it had received a surface inspection was placed in a testing machine and given a hydrostatic pressure test of 150 lb. per sq.in. While under this pressure, each joint was given a thorough hammering with a 2-lb. hammer. At that time it was thought that this was a rather severe test for a joint of this kind, but the writer was very desirous to ascertain just how much punishment an electrically welded joint would stand without damage. Only one joint was broken while the pipe was being tested. This one opened up for a distance of about 16 in. In examining this break closely it was found that the welder had dropped his spark three or four times within the distance mentioned. The weld was cut out and repaired, causing no further trouble during a second test. This pipe order was shipped to Tacoma by rail and distributed for a distance of less than half a mile at the site, by trucks. No trouble developed in this line after it was placed in service.

Several weeks ago the department ordered a number of short sections of 60-in. electrically welded pipe from a local company, which were made up of ⅜-in. flange steel. Among these sections was a 60 x 60-in. wye branch. Considerable trouble developed on one girth seam of the wye branch. This girth seam broke three successive times after welding and cooling. Small straps of 4 in. x 6 in. x ⅜-in. plate were then welded over the defective joint as reinforcing, spaced about 18-in. centers. After the joint had cooled with the straps in place, it became apparent from the distortion in the straps that the joint was again under considerable stress, proving the reinforcing of doubtful value. Finally it was decided to remove the small straps and place a 6-in. butt strap over the troublesome girth seam. This proved successful and no further difficulties were experienced. On account of the low head for which the 60-in. pipe is to be used, this pipe was given only a severe hammer test over all welded joints. The pipe was transported by truck from the shop to its destination, 16 miles, over good roads, without apparent damage and is now being installed on the McMillin reservoir bypass.

For all of the pipe mentioned, butt joints were called for in the specifications, with the edges bevel-sheared 30 deg. Test bars which were cut from a number of sections of finished pipe developed joint efficiencies of from 80 to 100 per cent, all breaks occurring ½ to 2 in. from the weld except in one case, where a test bar developed a joint efficiency of 72.8 per cent, breaking within the joint. On all of the pipe mentioned the welding was done by hand, and in justice to the pipe manufacturing company which furnished the pipe it should be stated that they have had years of experience in welding and made every effort to turn out a first-class job. In the writer's opinion, the personal equation, even of the experienced welder, is still a factor to be considered.

From information on machine-welded pipe it appears that uniform joints of better than 90 per cent efficiency can be obtained, but it is also stated by pipe manufacturers that machine welding is applicable only to the longitudinal joints and not to the girth seams, and it is certainly not only possible but very probable that in long pipe lines the thermal stresses in the girth seams might exceed those in the longitudinal joints on account of internal pressure.

I shall look forward with anticipation for expressions from other engineers on their experiences with electrically welded pipe.

W. A. KUNIGK,
Superintendent of Water-Works.

Tacoma, Wash.,
Nov. 21, 1925.

Does Desilting Affect Cutting Power of Streams?

Sir—Reference is made to the very interesting and instructive article by L. M. Lawson, project superintendent, U. S. Bureau of Reclamation, on "Effect of Rio Grande Storage on River Erosion and Deposition," in your issue of Sept. 3, 1924. Construction of Elephant Butte dam and subsequent operation of the huge reservoir created by it have produced a revolutionary change in the regimen of the Rio Grande without precedent in the United States. Some of the problems introduced into the operation of an irrigation system and some of the difficulties encountered in maintaining channel capacity in a silt-bearing stream depleted of its normal water supply have been aptly described, and the methods of solving them do credit to the engineers engaged on the work.

I have looked forward to the time when experience on the Rio Grande would point the way to what degradation may be expected when desilted regulated discharge is released from a reservoir into the channel of a former silt-bearing stream. Mr. Lawson summarizes a part of his observations as follows: "No great degradation of the river channel is found in the upper reaches of the river and such a tendency is retarded by the existence of diversion dams and canyon sections." In spite of the retarding tendencies mentioned, however, study of his Table II, Cross-sections of Rio Grande below Elephant Butte, indicates a decided degradation from Elephant Butte to Mesquite, a distance of nearly 100 miles. There may be doubt as to the adequacy of the cross-sections in the table as a basis for detailed calculations, and the form that these calculations should take is subject to some uncertainty, but the trend indicated is so positive that considerable reliance can be placed upon

ii. The pertinent data from Mr. Lawson's article may be summarized as follows, the values for slope being generalized approximations:

1. Elephant Butte to Garfield flume, 25 miles.
   Slope 4 ft. per mile; increase in channel area 64 sq.ft. per year at Garfield and, if assumed to be uniform throughout for the 25-mile stretch, equivalent to yearly degradation of 8,500,000 cu.ft., or 310,000 cu.yd. of 194 acre-feet.
2. Garfield flume to Detroit, 25 miles.
   Slope 4 ft. per mile; increase in channel area 49 sq.ft. per year (average of ends of section), equivalent to yearly degradation of 6,500,000 cu.ft., or 240,000 cu.yd., or 148 acre-feet.
3. Detroit to Picacho, 25 miles.
   Slope 4 ft. per mile; increase in channel area 29 sq.ft. per year (average of ends of section), equivalent to yearly degradation of 3,800,000 cu.ft., or 140,000 cu.yd., or 88 acre-feet.
4. Picacho to Mesquite, 20 miles.
   Slope 3 to 4 ft. per mile; increase in channel area 11 sq.ft. per year (average of ends of section), equivalent to yearly degradation of 1,200,000 cu.ft., or 43,000 cu.yd., or 27 acre-feet.
5. Mesquite to Anthony, 20 miles.
   Slope 3 ft. per mile; average decrease in channel area 5 sq.ft. per year (average of ends of section), equivalent to yearly aggradation of 530,000 cu.ft., or 20,000 cu.yd., or 12 acre-feet.
6. Anthony to Fabens, 50 miles.
   Slope 2 ft. per mile; channel area decrease 16 sq.ft. per year (average of ends of section), equivalent to yearly aggradation of 4,200,000 cu.ft., or 160,000 cu.yd., or 97 acre-feet.

It should be noted that for about 100 miles below Elephant Butte dam the Rio Grande not only has disposed of accretions of sediment from tributaries and arroyos subject to freshets but from 1915 to 1925 has actually eroded and carried downstream an average of 460 acre-feet a year derived from its bed and banks. Area for area the degradation evidenced in the river channel for 25 miles below Elephant Butte is probably 100 times as violent as the average on the basin tributary to the reservoir, in which some 20,000 acre-feet of silt are deposited annually. Moreover, the increase in channel volume from Elephant Butte to Mesquite is more than four times the decrease in channel volume from Mesquite to Fabens.

Considering the several stretches enumerated above, the degradation appears to be approximately a straight-line function of the product of slope and discharge. As these two factors decrease, going downstream, the power to erode and transport sediment is gradually lost until in the vicinity of Mesquite deposition begins. For the entire stretch of river from Elephant Butte to Fabens the tendency is toward a flatter channel slope. The indicated decrease in channel capacity from 1924 to 1925 might be taken as evidence that the flattening process had reached its limit as far upstream as Detroit, but it is more likely that the indicated decrease at Detroit and Picacho is only temporary. One would expect degradation to continue until, in the stretch above Mesquite, the river presents a series of flat slopes adapted to its load and carrying capacity interspersed with falls or rapids controlled by diversion dams or other obstructions to erosion. Perhaps before such time the capacity of the stream for erosion may be reduced by receipt of silt deposits from the reservoir. Then the problems of maintaining the proposed rectified channel will be multiplied.

Washington, D.C., Nov. 4, 1925.

HERMAN STABLER,
U. S. Geological Survey.

Sir—Mr. Stabler's comments on Rio Grande storage are interesting contributions to the subject which is of such importance in the operation and maintenance of the Rio Grande reclamation project.

The cross-sections which form the basis of his calculations reflect generally a limited amount of erosive action, due to changed conditions of flow and sediment. Such action would undoubtedly be much more distinct and of greater amount if obstructions to such effect were not present in the form of gravel beds, diversion dams, canyon sections and heavy deposits of arroyo sand. But for the presence of such retards and controls, an extensive channel degradation would have occurred and been reported. The complete records of cross-sections above El Paso show marked increases and decreases of area, depending upon the amount of flow and arroyo discharge of sand. The plotted cross-sections exhibit increases in areas in some cases, due entirely to side expansion.

Mr. Stabler's use of the word "degradation" is much more inclusive and larger in scope than was the writer's employment of it. As illustrative of the changed conditions of river sediment content at El Paso, due to the deposition of upper river silt and sand in Elephant Butte reservoir, the average annual amount of sediment in the Rio Grande at El Paso since the construction of the storage unit is approximately 3 per cent of that formerly discharged by the uncontrolled and unregulated river.

L. M. LAWSON,
Project Superintendent, Rio Grande Project,
U. S. Bureau of Reclamation.

El Paso, Texas,
Nov. 13, 1925.

Soil Research and Progress in Foundation Problems

Sir—Dr. Charles Terzaghi's articles on Soil Mechanics are of the greatest interest and value to the engineering profession. His experiments and no less his analysis of the results constitute, without doubt, the greatest step yet made, practically the first step toward a scientific understanding of the behavior of clay when stressed.

It is high time that scientific analysis should be applied to foundation problems. It is hard to understand why the engineering profession has been satisfied to rely on rule-of-thumb methods and indefinite comparisons based solely on "experiences." Experience, when the result of accurate observation of the facts connected with practical experiments on a large scale, is of value, especially if the lessons so learned can be applied to new and constantly-varying conditions. This evidently can be done only if we understand and measure all of the forces, and this in turn involves understanding the mechanics of the natural materials forming the foundation bed.

For a number of years I have been convinced that progress in this matter required laboratory experiments and that analysis of the results would establish relatively simple laws governing the behavior of granular and clay soils. In a small way, with limited time and primitive apparatus, I have determined for various fine sands and clays the approximate volume change of the mass and the equivalent loss of water due to increasing unit loads. I have used the results as a basis for estimating probable settlements and so-called safe loads. My results, so far as they go, are in line with and confirm Dr. Terzaghi's results.

Doctor Terzaghi's articles will undoubtedly evoke criticism—more appreciative, let us hope, than some contained in a letter published in your issue of Nov. 26. Thaddeus Merriman finds difficulty in comprehending stress of high intensity in clay. Experiments made for me in the laboratory of Columbia University established that a sample of *shale rock* freshly excavated from below water level lost 10 per cent of its volume when allowed to dry in air. This volume loss was the exact equivalent of the volume of the water loss in drying. In the process of drying, moreover, the solid rock was reduced to fragments; a similar sample, submerged in water immediately after being removed from the restraint of the surrounding rock masses, absorbed water to the amount of more than 12 per cent of its volume. From these experiments it is evident that shales may act as colloidal solids and that the stresses developed in drying exceed the tension value of the shale. Concrete itself as a colloidal solid is probably subject to the same influences.

New York City, Dec. 4, 1925.

DANIEL E. MORAN,
Consulting Engineer.

Contract Coal Stripping: N. P. Ry.

In the article on the extensive open-cut coal mining operations of the Northern Pacific Ry. in *Engineering News-Record* of Nov. 26, p. 867, the name of the contractors was accidentally omitted. It should have been stated that the contract was let to Foley Brothers, of St. Paul, Minn., who planned the equipment and methods of working, as described.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Water Pollution Symposium Held in New Jersey

Disposal Methods for Industrial and Ship Wastes Described—Operations by the State

One of the three sessions of the fifty-first annual meeting of the New Jersey Sanitary Association at Asbury Park, Dec. 4 and 5, was devoted to a symposium on the pollution of the waters of the state under the direction of Morris R. Sherrerd, chief engineer of the Newark Department of Streets and Public Improvements. In dealing with the treatment of sewage and the pollution from ship and trade wastes, George W. Fuller, consulting engineer, New York City, stated that industrial wastes in general can be treated by various methods similar to those used for municipal sewage. For oil wastes from refineries and ships, Mr. Fuller suggested oil skimming devices similar to the one in use on the Toledo sewage-works, for which his firm is consulting engineer. As regards both wastes on land and in water, Mr. Fuller stated that the engineer can do nothing unless he has administrative and financial support and legal authority, while the latter may have to be interstate and even international.

Conditions in Newark Bay

A paper on the "Effect of the Passaic Valley Sewer on Pollution of the Passaic River in Newark Bay" was read by J. Ralph Van Duyne, chief engineer, Passaic Valley Sewerage District, Newark. This system, which comprises 41 miles of main and trunk sewers from 1 to 12½ ft. in diameter, three pumping stations and settling basins, is the result of 30 years' agitation, promotion and construction work. The system went into operation Aug. 2, 1924. It is diverting the domestic sewage of many municipalities from the Passaic River and progress is being made in cutting out industrial wastes as well. Some of these are now discharged into the trunk sewer, some are being treated before discharge into the river, and studies for the treatment of others of the wastes before river discharge are being made.

Two papers on sanitary control of the shell fish industry were presented, one by John E. Bacon, chief of the Bureau of Chemistry of the New Jersey State Department of Health, and one by Dr. C. E. Waller, of the U. S. Public Health Service. Among other things, Mr. Bacon said that the State of New Jersey now has a scavenger boat service, which serves daily the fleet of oyster boats and also removes excreta from privy vaults on shore. Dr. Waller stated that under the new plan recently adopted, the Public Health Service has recently issued its first installment of certificates on the quality of oysters produced for shipment in interstate commerce.

In closing the discussion following this symposium, Mr. Sherrerd referred to control by the city of Newark of the pollution of its Pequannock River water supply, to which end the city has acquired 43 of the 63 sq.mi. of the Pequannock drainage area, at a cost of some $1,750,000.

The association elected as president for the ensuing year, Louis H. Richards, graduate of the Massachusetts Institute of Technology, who for nearly 28 years has been health officer of Elizabeth, and for first vice-president, Chester H. Wigley, lately chief of the Bureau of Engineering of the New Jersey Department of Health, now consulting engineer, New York City. Dr. Edward Guion, Atlantic City, and Herbert B. Baldwin, Newark, were re-elected secretary and treasurer, respectively.

Engineering Fifty Years Ago

From *Engineering News*, December, 1875

The Centennial

OLD "John Bull," the first locomotive ever run on the Camden and Amboy Road, which has been laid up in the Bordentown shops for many years, is being put in running order again, and will be sent to the Centennial next year. It was built by Robert Stephenson over 40 years ago, has 12 by 20 inch cylinders, one pair 4½ foot drivers, and weighs about 12 tons.

Record Rainfall at Miami

In 24 hours on November 29 and 30 over 15 in. of rain fell at Miami, Fla. The local weather bureau gives the following record of the storm:

5 min....	0.53 in.	2 hr.....	6.11 in.
10 min....	0.67 in.	3 hr.....	8.50 in.
15 min....	1.09 in.	4 hr.....	10.11 in.
30 min....	2.07 in.	14 hr.....	14.10 in.
1 hr.....	3.50 in.	24 hr.....	15.10 in.

The fall was continuous for 14 hours and was followed by a 1-in. fall toward the end of the 24-hour period. The total 15.1 in. fall and all amounts above 1 hour broke all Florida records.

The city of Miami was inconvenienced during and after the storm but no great damage was done. Streets were flooded and cellars and first floors filled and the electric power plant put out of commission, but by the next day conditions were normal with the exception of standing water nearly curb high in many of the streets.

Members of Muscle Shoals Inquiry Disagree

Committee Splits Three to Two and Issues Two Reports—Favors Private Leases

The Muscle Shoals Inquiry, appointed by the president on March 26, 1925, to assemble information as to the best disposition to be made of the government's power and nitrate properties at Muscle Shoals failed to come to an agreement as to all the details of the best method of using these properties and so have submitted two reports, a majority report signed by John C. McKenzie, Nathaniel Dial and R. F. Bower, and a minority report submitted by William McClellan and Harry A. Curtis. The whole committee is in agreement in favoring the leasing of the properties to private companies, the majority favors government operation if no advantageous lease can be arranged, whereas the minority is opposed to government operation because it would result in a waste of public funds. The majority favors leasing the power and hydro-electric plants as a unit and the minority takes the opposite view because it feels that the power and fertilizer industries do not understand each others problems and that advantage should be taken of the high skill in the production and marketing of power developed by the power industry and the technical skill of the chemical industry separately. Both reports favor the interconnection of the Muscle Shoals power plant with the electric power system of the surrounding territory.

The Majority Report

Briefly, the majority recommend that all the properties be leased as a unit for not more than 50 years at an annual rental of not less than 4 per cent of the actual cost of the dam, flowage rights, power house facilities, and such an amount of rental on the steam power plant as may be fair and reasonable, less an amount properly chargeable to navigation improvements; that the lessee be required to set up an adequate sinking fund to return to the United States the entire investment within the period of the lease, except in the case of permanent concrete construction for which the life of the sinking fund shall be extended; that the lessee be required to manufacture commercial fertilizers in an amount increasing to 70,000 tons in the tenth year of the lease; that the profit on this operation shall not exceed 8 per cent on the fair annual cost of production; that the lessee determine by research whether fertilizer compounds of higher grades and at lower prices than at present obtainable can be produced, and that the lessee employ such improved methods. If a lease cannot be arranged

the majority recommend immediate operation of the properties by the government, but it recommend such operation with "great reluctance." The majority recommends the construction of dam No. 3 provided it can be leased under the same terms as dam No. 2.

MINORITY REPORT

The minority report takes exception to that of the majority chiefly on the grounds that it does not make sufficient provision for applying the cheap power available at Muscle Shoals to fertilizer manufacturing and research and because it proposes terms of lease, which in the opinion of the minority will result in enormous profits to the lessee when the power possibilities of dam No. 2 are increased, that with the whole project leased to one concern the inclination will be toward diverting power from the production of fertilizer in order to sell it at high prices and the production of fertilizer by chemical rather than electrical processes.

The minority recommends the appointment by the President of a Muscle Shoals board of 5 members, such board to be empowered to lease the nitrate plant with certain restrictions. It also recommends that all the power at Wilson Dam with the steam plant at nitrate plant No. 2 be reserved for a period of 2 years from the time the necessary legislation becomes effective, and that 75,000 primary hp. together with 30,000 secondary hp. be reserved for an additional year, all for the purpose of manufacturing fertilizers under the supervision of the Muscle Shoals Board. (An appendix to the report estimates the primary power of the hydro-electric plant at 80,000 hp. and that of the steam plant at 76,000 hp. for 99 per cent of the time, it states, also, that during the past summer an unusual drought reduced the possible output of the hydro-electric plant to 38,000 hp.)

The minority places the annual rental of the power properties at 4 per cent of the present value estimated at $42,000,000; the lessee to construct at his own expense when so directed by the Federal Power Commission a power and storage dam at Cove Creek or some other site, to have the right for a period of 2 years to construct and operate dam No. 3 with power equipment, or should the United States government construct the dam, to have the right to lease the power. It recommends that the price of power to be sold under the lease be fixed triennially in order that the benefits from the decreased cost of production over and above a fair return to the lessee may accrue to the consumers of the power.

Work Started on New Railroad

The Northern Pacific Ry. has begun the construction of a 45-mile line from Orofino to Headquarters, Idaho. The railroad will go up the valley of the Orofino River to reach timberland on a plateau above the Clearwater River. Grading work will be heavy and the estimated cost is between 3½ and 4 million dollars. The contract for the work has been awarded to Twohy Brothers of Spokane, Wash.

Engineers Hear Discussion on Industrial Preparedness

Secretary of War Davis and Assistant Secretary MacNider addressed a joint meeting of the four founder engineering societies, the Army Ordnance Association, the American Chemical Society, and the Society of Automotive Engineers held in New York, Dec. 4, to discuss industrial co-operation with the War Department. The meeting marked the transfer of the supervision of this feature of the work of the War Department from Secretary Davis to his successor as assistant secretary, the new Assistant Secretary Hanford MacNider, and Secretary Davis in calling attention of the engineers to this transfer took the opportunity to outline briefly the splendid work that engineers and industrial leaders have already accomplished in co-ordinating their operations with the plans of the War Department.

Judge Gary, who presided, in introducing the Secretary of War and the Assistant Secretary, spoke against the present day critics of the War Department and cited the Secretary and Assistant Secretary of War as examples of the able men in charge of its affairs. With such men at the head he fears no lack of progress.

An unusual feature of the meeting was the ceremony of the transfer of the colors of the 24th Engineers from the custody of the United States Government to the custody of the United Engineering Society. Hereafter the colors of the 24th Engineers will be displayed in the Engineering Societies Building on West 39th St., New York.

Cincinnati Chooses Col. Sherrill as City Manager

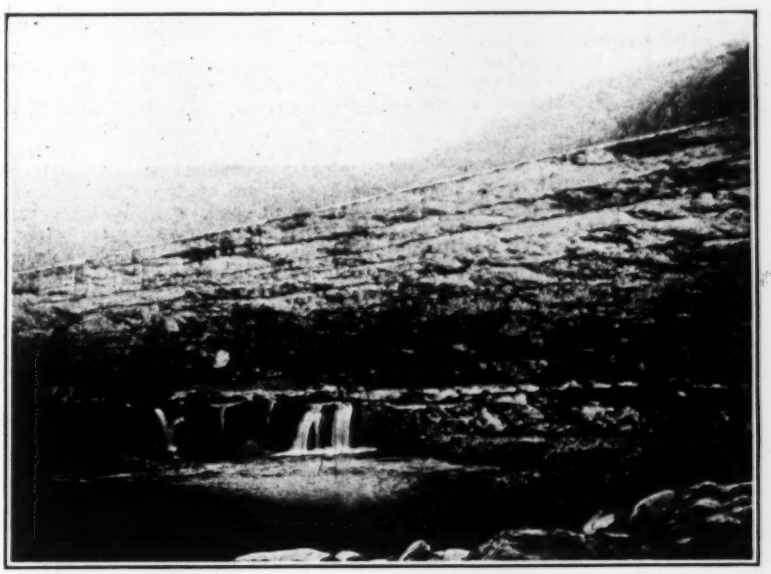
Lieut.-Col. Clarence O. Sherrill, U. S. Corps of Engineers, who since 1921 has been military aid to the President and director of the Office of Public Buildings and Grounds, Washington, D. C., has accepted the appointment of city manager of Cincinnati, Ohio, under the commission-manager charter that goes into effect Jan. 1. The salary is reported as $25,000 a year. It is expected that he will resign his army commission at once.

Col. Sherrill was born at Newton, N. C., in 1876. He graduated from West Point in 1901 and as second lieutenant was in charge of road, bridge and dock construction in Luzon and Mindanao, P. I., since when he has had various engineering assignments in the Corps of Engineers. For four years prior to his appointment to the position he is now leaving he was in charge of fortification construction throughout the United States.

Additional Port Facilities

The chairman of the Vancouver Board of Commissioners has announced that the board's plans include the immediate construction of a line of railway on the north shore, to provide rail connection for several miles of industrial sites. The north shore railway will be part of the harbor board's terminal system, which will serve industrial plants on the north and south sides. Up to the present the board has constructed a little over seven miles of terminal railway.

Dam in Wales Which Failed Through Undermining



Downstream side of the dam on Lake Eigiau in Wales which failed Nov. 2. The picture shows the breach in the lower part of the concrete structure, and beyond the hole eroded in the bed of the (now dry) lake. The flow of water from this opening resulted in the complete failure of a dam lower down in the same valley. It was the rush of water from the lower dam which resulted in the large loss of life and destruction of property in the town of Dolgarrog. A more detailed report will be given later.

Chicago Regional Planners Discuss Problems

Wide Streets Being Provided in the Outlying Districts—Water Supply Problem Serious

Highway congestion and relief, general surveys of future growth in all activities, public health including water and sewage disposal factors and subdivision platting and zoning were each subjects of special sessions of the Chicago Regional Planning Association Dec. 2 and 3 at its third annual meeting attended by about 300 people from cities within a 50-mile radius.

Cook County authorities are controlling subdivision platting outside of incorporated municipal limits holding to 100 ft. width of streets on section lines and 80 ft. on half section lines. At least two other contiguous counties have similar regulations. Representative cities as far away as Kenosha, Wis., and Michigan City, Ind., after describing their own efforts to control an orderly growth indicated that they would work in harmony with the regional plan.

To the question "when is a city plan completed?" Eugene S. Taylor, manager, Chicago Plan Commission, answered "when the major suggestions in the plan had been carried out." Some 300 plans had been made he said but less than a dozen "completed."

Water Contamination

Langdon Pearse, sanitary engineer, Sanitary District of Chicago, and A. E. Gorman, water control engineer, Chicago Department of Health, spoke of the extent to which Lake Michigan is being polluted by cities in the Chicago region. Both expressed the opinion that the flavor due to phenol wastes so prevalent in the water supplies of the cities at the south end of the lake could not be removed by filtration. Filters for all cities which use lake water and eventually sewage disposal plants or diversion of the effluents (one or both) eventually are essentials they stated.

Mr. Gorman stated that four times within a month sudden wind changes had practically exhausted the residual chlorine at the Sixty-eighth Street Station leaving no factor of safety and when the dosage had been increased to 6 lb. per million gallons the tastes rendered the water impossible to drink.

John Ericson, city engineer, Chicago, reported progress on the 10-year meter program, bids for the first installment of meters having just been received. When the full program is completed filters are possible and then water will be available for all the cities in the Sanitary District area in accordance with state law.

Charles B. Burdick, consulting engineer, whose firm has been working up plans for the Suburban Municipal Water Co., which proposes to furnish water to 20 cities just outside the Chicago city limits, said the cost would be about $400 per capita capital charges and $4 carrying charges. Hearings for a franchise of "convenience and necessity" before the Illinois Commerce Commission were scheduled for Dec. 8.

Close Bids on Subway Work at New York City

The bids on a portion of the 8th Ave. Subway, from 28th St. to 37th St., which were opened Dec. 8, show very close estimating. They are as follows: Rosoff Subway Construction Co., $5,888,000; Patrick McGovern, Inc., $6,131,000; Underpinning & Foundation Co., $6,202,000; Coleman Bros. & Co., $6,236,000; and Heyman & Goodman, $6,300,000.

Arrangements have been made with the University of Chicago and Northwestern University to handle certain phases of the general surveys. The latter will look into the reorganizing tendencies and the former population forecasts, geographical and natural factors of the larger contributory area in the Middle West to the growth of the Chicago region.

R. W. Putnam, major, Corps of Engineers, U. S. Army, who is in charge of the general surveys committee, indicated progress had been made to obtain basic data along three lines: collection of geographical data, vital statistics and economic surveys.

Highway Conditions

Highway conditions around Chicago were considered at one session, when the complicated situation, due partly to the great number of public bodies and authorities involved, was outlined by James T. Voshell, district engineer of the U. S. Bureau of Public Roads. The need of looking ahead and taking prompt action to improve the present congested conditions and provide for effective handling of the rapidly increasing traffic was pointed out by R. F. Kelker. He stated that the traffic is divided between the southern, northern and western gateways of the city in the proportions of 40, 35 and 25 per cent respectively. Representatives of the Illinois, Indiana and Wisconsin highway commissions outlined the inter-relations of the state highways serving Chicago, special stress being laid on the extensive tourist traffic in Wisconsin and the great industrial development in the Calumet district, south of the city. Although motor-trucks are generally assumed to constitute a large proportion of the highway traffic around Chicago, it was stated by Peter S. Theurer, of the Truck Owners' Conference, that independent surveys by his organization and the Cook County authorities show the average to be only about 4 per cent, with a maximum of 6.7 per cent on the one busiest road.

President Re-elected

At the annual dinner, the construction of broad arterial highways radiating from Detroit was described by S. D. Waldon, of the Detroit Rapid Transit Commission, and the regional city of the future was visualized by Jacob L. Crane, Jr., of Chicago. D. H. Burnham was re-elected president of the association.

Water-Works Operators of Iowa Meet at Dubuque

With a hundred members and guests in attendance at the Dubuque meeting of the Iowa Section of the American Works Association, a heavy program of six sessions ran the gamut of water-works problems from speeding up coagulation at Omaha to financial reports and budgeting at Cedar Rapids.

A. T. Luce, superintendent and manager, Marshalltown, described an unusually difficult job of rehabilitating a run-down plant in bad shape financially and physically. George W. Putnam, Missouri chief sanitary engineer, said that his state was in need of skilled operators of both water filters and sewage-works. Kenneth C. Armstrong, assistant chemist, Omaha Metropolitan Utilities District, told of being able to reduce the amount of coagulant used at the filter plant by laboratory control, using a bottle-shaking machine and introducing a small amount of ferrous sulphate before the introduction of the alum. Mr. Armstrong did not advance any opinion as to why the alum floc formed faster and larger after the ferrous sulphate application but Dr. A. M. Buswell, Illinois State Water Survey, suggested that it acted as a catalyser "setting off" the development of aluminum hydroxide flocculation.

How to get low costs by better organization and improved equipment was discussed by H. V. Knouse, construction engineer, Omaha Metropolitan Utilities District. Practically all work is done by force account, the skeleton organization held throughout the winter, though foremen and caulkers may have to do laborer's work. Other factors are careful planning of the order in which work is done so as to move the equipment a minimum, having trenches open and all specials on the ground ready for pipe-laying gangs, and furnishing foremen with complete maps. Several special tools have been developed. Backfillers are built on Fordson tractors and by stripping in a few minutes are available as tractors. Washing out of trenches on steep streets after rains is obviated by building timber bulkheads at intervals of from 50 to 200 ft. Cheap signs warning against soft trenches have saved the District much litigation. A 2-hour Saturday afternoon school or conference for foremen has contributed much to the training and morale of the force.

In accordance with former programs, the water-works manufacturers provided a dinner and entertainment for an evening session.

Among the officers elected for next year are: Chairman, H. V. Knouse, and vice-chairman, J. P. McEvoy. Jack J. Hinman, Jr., continues as secretary-treasurer.

River Diversion at Denver

At Globeville, a suburb of Denver, Colo., $100,000 is to be spent in building a new channel for the Platte River to provide protection against floods and in filling in the old channel of the river.

Reconstruction of High Bridge at New York Approved

The Board of Estimate of New York City, overruling an objection of the controller, has approved the plans and specifications for the reconstruction of High Bridge over the Harlem River at an estimated cost of $1,013,273. The board took this action in order that the project might be approved this year and so make it possible for the Army engineers to include expenditures for the government's part of the work in their estimates for next year.

A House for Tom Lee of Memphis

Last May, Tom Lee, a negro boatman on the Mississippi River below Memphis, providentially happened along when the government boat *Norman* turned turtle and precipitated the civil engineers' convention into the river. Out of sixty-seven people Tom saved thirty-two. Twelve more either swam ashore or were helped. The Engineers Club of Memphis and the Memphis *Commercial Appeal*, as a substantial reward to Tom Lee, collected a fund of $4,000 with which was purchased a house costing $2,750 and an annuity for taxes, etc. Tom moved in early in November. The cottage is on a 90 x 100-ft. lot, has a good garden and room for chickens. (The engineers naively suggest that Tom is racially better qualified than they are to acquire the chickens.) Permanent trustees have been appointed by the engineers and the *Appeal*, two engineers and a lawyer, all of whom were survivors of the Norman disaster. The deed to the house was made to the trustees so that Tom will not be tempted to trade in his house on some get-rich-quick deal.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 11-15, 1926.

AMERICAN ENGINEERING COUNCIL, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 14-15, 1926.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Portland, Ore., Jan. 19-23, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 20-22, 1926.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Toronto, Ont., Jan. 27-29, 1926.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 23-26, 1926.

The National Association of Railroad Tie Producers will hold its eighth annual meeting at Cleveland, Ohio, Jan. 28 and 29; secretary, John S. Penney, St. Louis, Mo.

The American Wood Preservers' Association will hold its annual convention at Cleveland, Ohio, Jan. 26 to 28; secretary, E. J. Stocking, Chicago.

American Engineering Council will hold its annual meeting in Washington, D. C., Jan. 14 and 15; the Executive Committee and the Administrative Board for 1925 will meet in Washington Jan. 14.

The Kentucky-Tennessee Section of the American Water-Works Association—a newly organized section—will hold its first meeting Jan. 13-14, 1926, at Louisville, Ky. F. C. Dugan, who may be addressed in care of the Kentucky State Board of Health, 532 W. Main St., Louisville, Ky., is secretary of the section.

The International Association of Street Sanitation Officials will hold its annual conference Jan. 11 and 12 at Chicago. A. M. Anderson, secretary, 10 South LaSalle St., Shicago, states that the following are scheduled topics: Increased service and comparative costs; tax reductions; relation between type of pavement and maintenance; department personnel and compensation problems.

At The International City Managers' Association recent annual meeting, reported on p. 889 of our issue of Nov. 26, Harrison G. Otis, city manager of Clarksburg, W. Va., was elected president and Colorado Springs, Colo., was selected for the 1926 meeting place. John N. Eddy, city manager, Berkeley, Cal., was elected as vice-president and John G. Stutz, Lawrence, Kan., was continued as secretary.

Personal Notes

ARTHUR L. LAROCHE, commissioner of public works at Binghamton, N. Y., since 1920, and previously deputy city engineer there, has joined the San Lucie Plaza engineering staff at Fort Pierce, Florida, for service in municipal engineering.

AXEL H. OXHOLM, chief of the Lumber Division of the Bureau of Foreign and Domestic Commerce, of the U. S. Department of Commerce, has been appointed director of the National Committee on Wood Utilization, and for a time will carry the duties of the two positions.

F. S. LAZIER, division engineer, sections 3 and 4 of the Welland ship canal, has resigned and has joined the T. A. Brown Co., general contractors, Toronto, Ontario.

EDWARD J. FUCIK, vice-president and director of the Great Lakes Dredge & Dock Co., has resigned to become vice-president and director of the Fitz-Simons and Connell Dredge & Dock Co., Chicago. Starting seventeen years ago with the Great Lake Co., Mr. Fucik has been successively engineer, superintendent, general manager and for the last four years, vice-president. He is a graduate civil engineer, University of Illinois, 1901, and for some years following served with the Sanitary District of Chicago on construction of bridges over the Chicago River and on dredging work in the river; he also at about this time worked on dam and canal lock construction at Lockport, Ill. Some of the construction works of which he had charge for the Great Lakes company were locks at Sault Ste. Marie and a concrete dry dock in South Chicago.

A. D. SWAN, consulting engineer, Montreal, has been awarded the Telfer Premium by the council of the Institution of Civil Engineers, London, for the session 194-25, for selected engineering papers published without discussion.

BENJAMIN ASCHER has opened offices at 1457 Broadway, New York City, under the name of Ascher Engineering & Construction Co., doing a general contracting business, particularly buildings. Mr. Ascher was formerly director and chief engineer of the Joseph L. Burke Corporation, now being dissolved.

ROBERT ISHAM RANDOLPH, consulting engineer, Chicago, has been elected vice-president of the Chicago Association of Commerce heading the division of industrial development and public improvements.

Obituary

JOHN CAMERAN PATTERSON, for many years connected with the engineering department of the Great Northern Ry., died at Los Angeles Nov. 6. Mr. Patterson was born at Lawrence, Mass., in 1858, and graduated from the civil engineering department of Maine State College in 1878. In 1880 he entered the service of the St. Paul, Minneapolis & Manitoba Railway Co. and for eight years was employed as an assistant engineer on surveys and construction. From 1889 to 1895 he was on similar work with the Northern Pacific Ry. and from 1895 until 1902, with the exception of a few months in which he was employed on the construction of the Butte, Anaconda & Pacific R.R., he was resident engineer of the Montana Central Ry. at Great Falls, Mont. In 1902 he was transferred to St. Paul as resident engineer on the Great Northern, in 1903 became principal assistant engineer and in 1906 assistant chief engineer, remaining in that position until 1913. The following three years he was on construction with A. Guthrie & Co., returning to the Great Northern in 1917 for five years as assistant engineer on valuation work.

WILLIAM WYLIE, civil engineer, Washington, Pa., and at one time county engineer of Washington, County, died Dec. 6 at his home in Washington, aged 66 years. Besides his county engineering work, Mr. Wylie was connected with street railway construction in Newcastle, Ind., and between Goshen and South Bend, Ind.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

British Trade Status in South America

Association Formed in London to Direct Public Opinion to Possibilities for Increase

TO PROMOTE the increase of British trade in South American countries, which are regarded as offering one of the greatest markets of the world, the Anglo-South American Association has been organized in London, with Sir Robert Hadfield, the steel engineer and manufacturer, as one of its vice-presidents. The following is from a statement by S. Heckstall Smith, secretary of the association, with offices at 25 Haymarket, London, England:

"This association has only one object, to inform public opinion on the vital urgency of recapturing the great Latin-American markets. It is felt that the time has come to take a definite stand, and to win back the ground we are rapidly losing in what today are considered to be the world's richest markets. We want to get more South American orders for Great Britain. We want South America to buy British goods to the extent justified by the British capital that is invested in the vast developments of the Latin-American continent. We want to draw the attention of the British manufacturer and trader to the untouched possibilities of the seventeen South American republics.

"British investments in South America amount to over $5,500,000,000. Even in the comparatively small and unexploited Venezuela we have $5,000,000 and it is significant that nearly all the latter's rich oil and mine workings have been subsidized by British money. South America wants to trade with us more than anybody. The South American republics have never forgotten what the British people did for them in the cause of Latin-American freedom. They would rather see our ships and traders than those of any other country in the world, and we intend to see that this fact is brought home to everybody in Britain, and particularly to our traders whose commerical interests can be directed to South America.

"Higher prices, due to higher wages, have not been the only reason why we have lost our South American orders. We have not shown the energy, the enterprise and the personal enthusiasm of our competitors. Informed public opinion can alter this. Today South American markets are, in effect, the greatest and perhaps the only markets in the world where we can hope completely to recover our prosperity from the appalling industrial setbacks of the last eleven years. Germany has not been slow to see its possibilities, nor has the United States. The rapidly-growing markets of South America are waiting for us, and this association is determined by sheer force of public opinion to see that the markets are not almost entirely seized by our competitors."

Pelton Turbine at the Pit River Power House No. 3

In an account published in *Engineering News-Record*, Nov. 19, 1925, p. 858, it was stated that an impulse wheel at the Pit River power house No. 3, of the Pacific Gas & Electric Co., had showed an efficiency of 93 per cent in some recent tests. This statement was in error and should have read "reaction wheel" instead of "impulse wheel."

Concrete Road Yardage

For November the square yardages included in concrete pavement contract awards, according to the Portland Cement Association, were: 1,717,613 for roads; 1,626,602 for streets; and 143,582 for alleys; or a total for the month of 3,487,797 sq.yd.

The accompanying table summarizes the statistics for the current year:

SQUARE YARDS OF CONCRETE PAVEMENT AWARDED DURING 1925

Month	Roads	Streets	Alleys	Total All Classes
Jan.....	3,474,421	963,256	75,236	4,512,913
Feb.....	3,787,192	1,201,224	58,723	5,047,139
March..	5,728,862	2,483,662	190,553	8,403,077
April...	12,462,646	4,431,220	469,117	17,362,983
May....	7,724,075	4,169,707	392,656	12,286,438
June....	5,980,857	3,904,733	335,981	10,221,571
July....	6,361,686	5,147,203	535,156	12,044,045
Aug....	6,368,201	2,973,301	252,341	9,593,843
Sept....	4,087,442	5,018,902	624,006	9,730,350
Oct.....	3,710,836	2,163,903	260,642	6,135,381
Nov....	1,717,613	1,626,602	143,582	3,487,797
Totals	61,403,831	34,083,713	3,337,993	99,825,537

A. B. Wood Joins Fairbanks-Morse Organization

A. B. Wood has served for many years as sanitary engineer of the Sewerage and Water Board of the city of New Orleans and has now joined the Fairbanks-Morse Co., Chicago, in a consulting capacity. Mr. Wood is the inventor of the Wood screw pump and the Wood trash pump which have been used for many years in the sewage and water-works field. These two pumps have been added to the Fairbanks-Morse line of special application pumps and will be manufactured and distributed by Fairbanks-Morse & Co.

Although both pumps are of the rotating type, they are intended for entirely different kinds of pumping service. The trash pump was designed to meet the sewage disposal conditions at New Orleans. The peculiar advantage of the pump is its ability to handle the fibrous and stringy materials that occur so largely in the city sewage. It is claimed that the pump will pass any material that can enter the suction nozzle.

The screw pump is also an outgrowth of Mr. Wood's experiences in draining the city of New Orleans. It is designed to move large quantities of water against a low head. It consists of a siphon in the summit of which rotates a specially designed screw type impeller. It is a single suction device that is furnished in a reversible type which may be operated in either direction in accordance with the work to be done and in a non-reversible type which can be operated in one direction only.

Proposed Simplification of Shovels, Spades and Scoops

In accordance with the unanimous action of the joint conference of representatives of manufacturers, distributors and users of shovels, spades and scoops, the U. S. Department of Commerce, through the Bureau of Standards, recommends that the recognized stock grades, finishes and number of shovels be reduced. This recommendation if approved by the industry is to become effective May 1, 1926, subject to annual revision of the standing committee of the industry, according to George K. Burgess, director, Bureau of Standards.

Practically all shovels, spades and scoops are to be finished in black only. Three grades of shovels instead of four are recommended, with no shovels of a lower grade to be manufactured. The U. S. standard gage was unanimously adopted.

Business Notes

T. L. PITTS, sales representative at Charlotte, N. C., for the Osgood Co., manufacturers of excavating machinery, has recently been promoted to division sales manager, in charge of sales in the South Atlantic seaboard territory.

H. A. WATKINS has recently been appointed metropolitan district sales manager of the Bridgeport Brass Co., Bridgeport, Conn., with offices in Pershing Square Bldg., New York City.

W. J. NUGENT, vice-president and general manager, the Nugent Steel Castings Co., Chicago, was recently elected president to succeed Charles Piez. Prentiss Coonley was elected vice-president and C. A. MacDonald, secretary, was elected to fill a vacancy on the board of directors.

CLIMAX ENGINEERING CO., Clinton, Iowa, announces the appointment of T. L. Keeling as its sales representative for Ohio, Western New York, and Western Pennsylvania with offices in Cleveland.

LINDE AIR PRODUCTS CO., New York City, announces the election of G. W. Mead, formerly president, to the position of chairman of the board of di-

rectors. W. F. Barrett, formerly vice-president was elected to the presidency. In addition to these changes, R. R. Browning was elected vice-president in charge of sales and J. A. Rafferty, vice-president in charge of engineering, manufacturing and research.

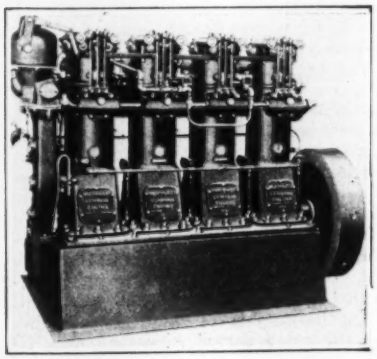
WALLACE & TIERNAN CO., INC., Newark, N. J., has recently acquired the exclusive license covering the installation in North America of the Henderson-Haggard process for the deodorization of noxious gases by means of liquid chlorine. The company has always manufactured the control equipment necessary for this installation.

WEHR CO., Milwaukee, Wis., announces the recent appointment of G. C. Salisbury as sales manager. Mr. Salisbury was a Wehr distributor in Wisconsin prior to his more recent connection with the Electric Co. of Milwaukee, where he handled street paving problems. D. C. Myers, who is now relieved of sales manager duties by Mr. Salisbury, will continue to act as general manager of the Wehr Co.

Equipment and Materials

New Diesel Engine for Shovels and Cranes

The use of four cylinders in the new Northwest-Cummins Diesel engine, manufactured by the Northwest Engineering Co., Chicago, is claimed to eliminate all objectionable vibration and to assure smooth operation. The new engine starts from stone cold without the aid of torches, electric hot spots or other similar device, and runs at a full Diesel compression of 500 lb.



pressure. It is claimed that a special means of fuel injection results in complete combustion. The fuel pressure is 50 lb., which makes possible the use of needle valves of simple type and allows accurate metering. Air is injected with the fuel as in the original Diesel but instead of coming from a high pressure air compressor it comes from the combustion chamber itself on the compression stroke.

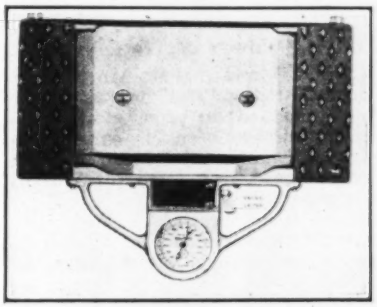
The four cylinders of the new engine are cast separately, allowing removal of either half of the five main bearings as well as the removal of any cylinder. It is claimed that the water jackets never approach the boiling point, even after hours of work on hot days. Lubrication is full pressure feed throughout.

A small gasoline engine and an air compressor are provided for starting. The compressor charges a small storage tank that has a capacity for from 10 to 15 starts.

The company states that the primary advantage of this engine is low cost of operation, in some cases being as low as 90c. a day, but also remarks that the Diesel engine is not suited to every class of work and should be confined to those jobs where the work covers a long period, is continuous and where fuel is a large item of expense.

Improvements on Device for Weighing Motor Trucks

The Loadometer, a device for road officials and others interested in the rapid weighing of motor trucks, has incorporated several new improvements as announced by Black & Decker Mfg. Co., Towson, Md., who makes the equipment. Among these improvements is a zero correction screw, mak-

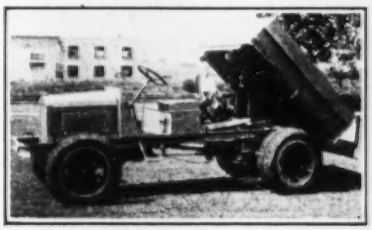


ing it possible to correctly calibrate the instruments in a moment's time. In order to relieve the gage from the sudden schock caused by heavy truck wheels mounting upon the platform, a lever valve has been used which may be thrown in an on or off position. A diamond tread on the gradual approaches to the platform eliminates the possibility of a truck tire slipping. A heavy guard has also been placed at the inside edge of the platform to protect the gage from damage should the Loadometer be placed incorrectly under the wheels. The Loadometer is made of almuinum alloy and weighs 43 lb. The platform is 9x13 in. The Loadometer is furnished in capacities of 7,000, 15,000 and 20,000 lb.

Road Builders' Trucks Improved for Safety and Higher Speed

Designed especially for highway construction and maintenance work, the new Model H4K truck of the Hug Co., Highland, Ill., combines a low center of gravity with even weight distribution on all four wheels, thus contributing to both safety and higher speed. The steel body is dumped by an underbody hydraulic hoist, and all operations are completely controlled from the driver's seat with positive lever positions for holding, raising or lowering.

The chassis is equipped with a new tire adapter on the rear wheels which permits the changing of tires without

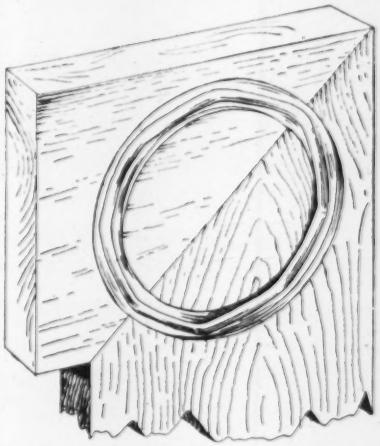


removing the wheels from the axles as is necessary with many dual tire wheels when the inside tire must be reached. The chassis is also equipped with a special rear spring suspension which provides for easy riding whether the truck is empty or loaded. There is a light resilient spring member that carries the body when the truck is empty and a substantial hanger and supplementary torque arm braces the axle for positive protection against strain to the drive shaft in a heavy pull.

The power unit on the truck is a Buda model KTU four-cylinder engine. The wheel base of the truck is 121 in., its maximum load capacity 7,500 lb., and its maximum speed 30 m.p.h.

Ring Clamp Holds Lumber Joints Together

A metal ring used for joining lumber is constructed of a ring of spring steel, corrugated to a smaller internal diameter than the groove into which it is to be seated. It is expanded over a hard steel cone by being forced over the cone into the circular groove at the lumber joint. The ring is discharged from the larger end of the cone while



in an expanded condition. Thus the ring becomes a clamp, and whatever pressure is required to expand the ring is then exerted to hold the joint together. It is claimed that the pressure can be set to over two tons for each ring. The wood may shrink but the ring takes up the slack that would come

in ordinary dry stock. When the wood swells, it is claimed that the ring moves with it. W. L. Evans, Washington, Ind., has patented these rings and also the machines by which they are made.

Publications from the Construction Industry

Protected Hand Lamps — CROUSE-HINDS CO., Syracuse, N. Y., illustrates its safety hand lamps in a bulletin just issued. The equipment consists of heavy aluminum alloy cages surrounding the electric light or lantern. They are specially designed for rough construction use.

Steam Shovels—MARION STEAM SHOVEL CO., Marion, Ohio, in Bulletin 316, describes its 3-yd. steam and electric shovel. Text and photos describe construction details as well as the operating machinery for both the steam and electric pipe.

Trademarks and Patents—RICHARDS & GEIER, attorneys, 277 Broadway, New York City, have published some information useful to engineers and manufacturers preliminary or supplementary to the employment of patent attorneys in two concise pamphlets on Patents: Law and Practice and Trade Marks, Trade Names, and Fair Competition, now in their third and fourth editions, respectively.

Electric Motors—RELIANCE ELECTRIC & ENGINEERING CO., Cleveland, Ohio, has just made available its bulletin No. 4000, describing its ball and roller bearing motors, designed for both d.c. and a.c. All the important details of the motors are illustrated and described; in addition tables giving the bearing sizes used on the different types of motors are given. Tables, dimensions and photos of typical installations in various plants complete the booklet.

Portable Hoists — SULLIVAN MACHINERY CO., Chicago, has devoted its latest bulletin No. 76-F to its line of "Turbinair" hoists. Descriptions of the hoists, their working advantages, and a number of typical construction views featuring these hoists comprise the subject matter in the bulletin.

Compressors and Pumps—PENNSYLVANIA PUMP & COMPRESSOR CO., Easton, Pa., devotes its bulletin No. 125 to descriptions of its general products, including stationary and portable compressors of various types and single multi-stage centrifugal pumps.

Precast Concrete Units in Railway Work—THE PORTLAND CEMENT ASSOCIATION, Chicago, has issued in pamphlet form the report of a committee of the American Railway Bridge and Building Association describing the manufacture and use of various precast concrete units, ranging from bridge slabs, piles and structural members for buildings, to pipe, cribbing, posts, water troughs and track signs.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
December 10, 1925	$12,554,000	$31,584,000	$44,138,000
December 3, 1925	17,931,000	37,255,000	55,186,000
December 11, 1924	7,782,000	13,315,000	21,097,000
Heaviest Week			
1925, Sept. 3	16,215,000	69,424,000	85,639,000
1924, May 8	26,370,000	38,829,000	65,199,000
January 1 to Date			
1925	993,986,000	1,424,416,000	2,418,402,000
1924	928,135,000	982,028,000	1,910,163,000

Buying Power of Wages Greater as Unit Cost of Production Drops

A BROAD and distinct tendency toward rising "real" wages, that is wages measured in terms of what the worker can buy with his earnings, is traced by the National Industrial Conference Board, in a comparative study of representative industries.

Increased application of power, better utilization of labor, mechanical ingenuity and managerial efficiency, according to the Conference Board, are steadily tending to reduce unit cost of production, thereby cheapening the general cost of living with resulting increasing prosperity for all.

While this tendency is not equally noticeable in all industries, the differences in wage levels and cost of production are largely attributable to the different degree of efficiency of production prevailing in the respective industries, the board points out in comparing conditions in major industrial branches. The iron and steel industry, according to the Board's analysis, is a striking example of what progressive, modernized methods can do. While wage levels in the iron and steel industry are now about 140 per cent above the pre-war level, according to the Conference Board's study, the average price of its products at present is only about 34 per cent higher than in 1914. In other words, while wages of iron and steel workers are nearly two and a half times as big as they were before the war, average prices of iron and steel products have risen only about a third.

Another notable illustration of this tendency of declining costs, benefiting the wage earner within the industry as well as the consumer at large, is the automobile industry, where wage levels now are about 122 per cent higher or more than double of what they were before the war, while average prices of automobiles are actually 29 per cent lower than in 1914, an instance signally reflecting the improvement of industrial processes.

Similar conditions are found to obtain in the chemical, foundry and machine shop, the rubber, furniture, leather and other industries. The same is also true of the public utilities generating gas and electricity, where wages are more than double of what they were in 1914 (116 per cent higher), while the cost of gas and electricity for domestic consumption, as estimated by the Conference Board, averages only 40 per cent higher than the 1914 level.

The important role played by administrative and technical progress in lowering the unit cost of production is brought out in a separate study by the Conference Board of the volume of production as compared with the application of power and number of wage earners during the last quarter of a century. The total volume of production from 1899 to 1923, according to this study, increased 185 per cent, "installed primary power" 236 per cent, while the number of wage earners during the same period increased only 90 per cent. Since 1914, however, the Conference Board points out, both the application of power and the number of wage earners have increased less than the volume of production, conclusively showing the advance in efficiency of management in utilizing both machinery and labor.

The concrete result of this increased industrial efficiency, the Conference Board study declares, is reflected in the fact that while the American workman to day, if we measure the purchasing value of his earnings in terms of the same standard of living as prevailed in

(*Continued on p. 978*)

Tightening of Rediscount Rate May Exert Depressing Influence Upon Speculative Building

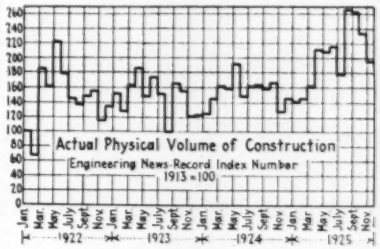
THAT expansion and contraction in volume of construction varies inversely with the rise and fall of the rediscount rate is shown in the accompanying illustrations.

In the first quarter of 1922, when the volume of construction was smaller than at any time since then, the rediscount rate in all of the twelve Federal Reserve Districts was higher than during any subsequent period.

Later in the year 1922, the rate dropped half a point and volume rose abruptly. While most of this was seasonal gain, the high mark of the year was considerably above any point in the succeeding two years.

In the latter part of 1923 and the first part of 1924 the rate rose half a point in New York, Boston, and San Francisco. Volume accordingly, dropped to a point nearer the low mark of the 1922-25 boom period.

Mid-summer of 1924 witnessed a decline in the rediscount rate of a full point in five of the cities, and half a point in the other seven. Volume advanced at that time to a point a trifle above the high mark of 1923.

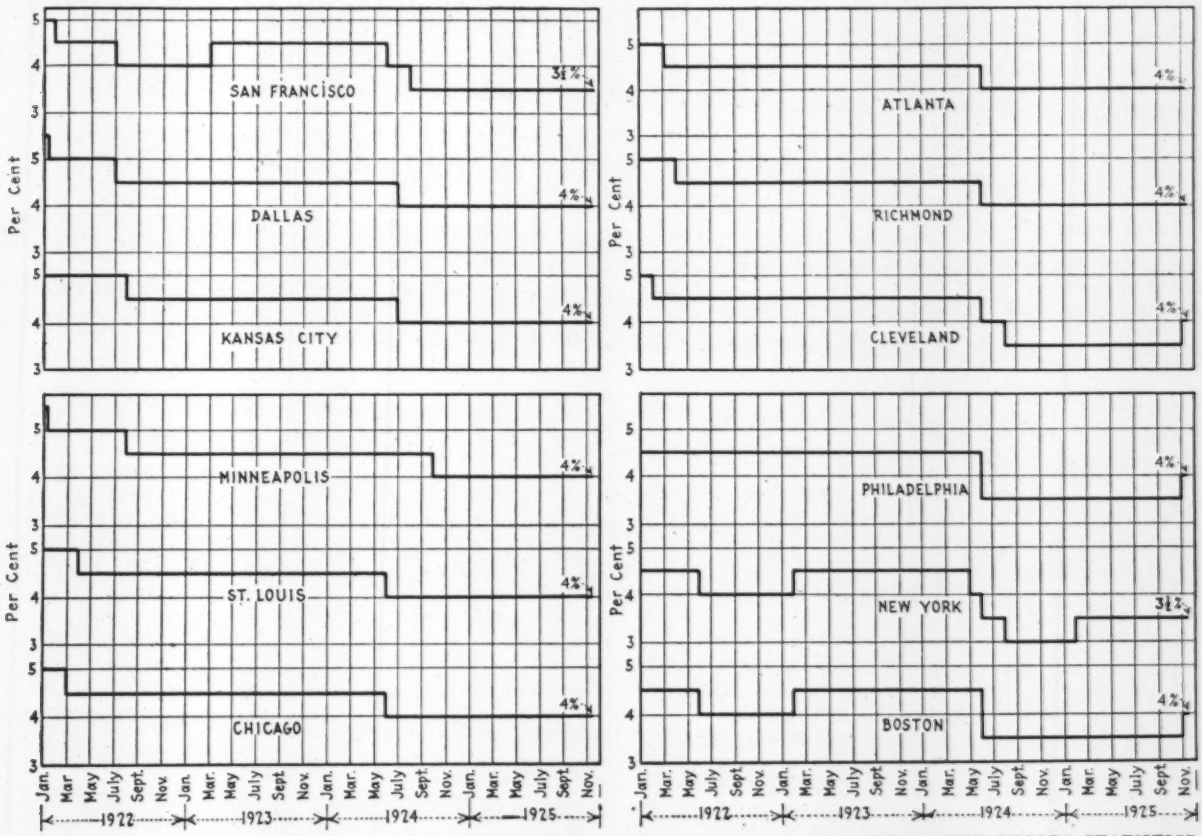


With the Federal Reserve rate at 3½ per cent in five of the districts and at 4 per cent in the other seven, throughout the greater part of the current year, volume mounted to record monthly levels, reaching the peak in August, 1925.

The advance from 3½ to 4 per cent in Cleveland, Philadelphia and Boston, during the past month, leaves but two cities, New York and San Francisco, at the 3½ per cent level, the rest maintaining 4 per cent.

While the November drop in construction volume is purely seasonal, as shown by similar declines for that period, depicted in the accompanying chart, the recent rise in the rediscount rate will undoubtedly have a depressing effect upon loans for speculative building.

Since at least 68 per cent of all construction lies in the class most affected by speculative excesses, a further tightening of the rediscount rate may seriously retard the building program for 1926.



FEDERAL RESERVE RATE ON ALL CLASSES OF REDISCOUNTABLE PAPER—ENGINEERING NEWS-RECORD STATISTICS

Foreign Projects of Interest to American Contractors

FOLLOWING are several of the most important projects recently reported by the Bureau of Foreign and Domestic Commerce:

Boulevard, Montevideo, Uruguay, project approved by Departmental Assembly, $9,000,000.

Railway line, Spain, Government loan successfully floated, 500,000,000 pesetas.

Three new highways, road repair work, monument and park, aqueducts, water supply system, Havana, Cuba, part of a $300,000,000 program.

Incinerating plants, Buenos Aires, Argentine, authorization requested by Mayor, 2,000,000 pesos.

Sewerage system, North Toronto, Canada, expenditure authorized by City Council, $11,000,000.

Highway, Concepcion to Talcahuano, Chile, loan partly guaranteed by Central Government, 1,700,000 pesos.

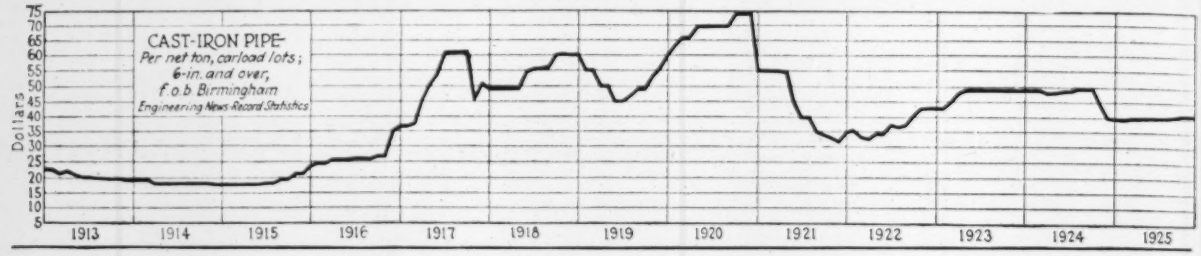
Highway, Cologne to Aachen, Germany, approved by Diet, Rhine Province, $6,428,571.

Railway, Finland, money to be granted by Council of State, 1926 program, 71,000,000 marks, 100,000,000 marks yearly, thereafter. Reference No. 189,532.

Weekly Construction Market

NO DEFINITE downward trend in price is shown by any of the principal building materials in the current market. While declines appeared during the week in certain sections, on such materials as c-i. pipe, structural timbers and linseed oil, these were promptly met by advances on the same materials in other localities. The base rate for bricklayers in New York City is now $1.50; that of carpenters $1.31¼; and hod carriers, $1 per hr. Compared with the 1914 level, this represents a rise of 100 per cent for the bricklayers; 110 per cent for the carpenters in Manhattan and 166.6 per cent for the hod carriers.

If the 1926 wage demands for these trades become effective, it will place bricklayers at 166.6 per cent; carpenters, 140 per cent; and hod carriers, 233.3 per cent above the 1914 schedule.



	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.90	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$3.75
Structural rivets, 100 lb.	4.50	4.45	4.75	3.50	3.75	4.65	5.00	3.75	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.40	3.38	3.00	3.25	3.77½	3.35	3.25	2.30
Steel pipe, black, 2½ to 6 in. lap, discount	48%	55%	53.6%	51%	54.25%	36%	39.2@51%	45%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@52.60	—46.00	54.00	+50.20@51.20	53.00	+64.00	53.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.70	+2.35	2.05	2.10	2.32	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd.	1.75	2.20	2.38	2.00@2.20	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.65	2.00	+2.25	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.20	2.83	2.00@2.20	1.75	2.50	2.15	3.00	1.50
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	61.00	34.00	—56.00	+57.00	+36.75	—32.75	27.00	25.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl.	2.25@2.75	1.30	1.85	1.30	1.35	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	17.50@19.50	10.50	11.10	12.00	13.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	0893	.10	.075	.....	.075	.....	.10	.12
Hollow partition tile 4x12x12, per block	+.1112	0893	.10	.075	.07	.075	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal.	.99	+1.08	1.13	—.99	1.11	1.24	1.11	1.12	1.14
Common Labor									
Common labor, union, hour	.62½@.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.45@.55	.35@.50	.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅓c.; building laborers, 75c.; excavating laborers, 55c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job; pine is 4-in. instead of 3-in.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 3, the next on January 7.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.031). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Buying Power of Wages Greater

(*Concluded from p. 976*)

1914 but discount the rise in retail prices, is 24 per cent better off than he was at the beginning of the war (in July, 1914), and 5 per cent better off than at the peak of wage earnings during the inflation period of 1920.

On December 1, 1925

E. N.-R. Construction Cost Index Number 205.95

E. N.-R. Construction Volume Index Number 194

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month